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MAY 1983

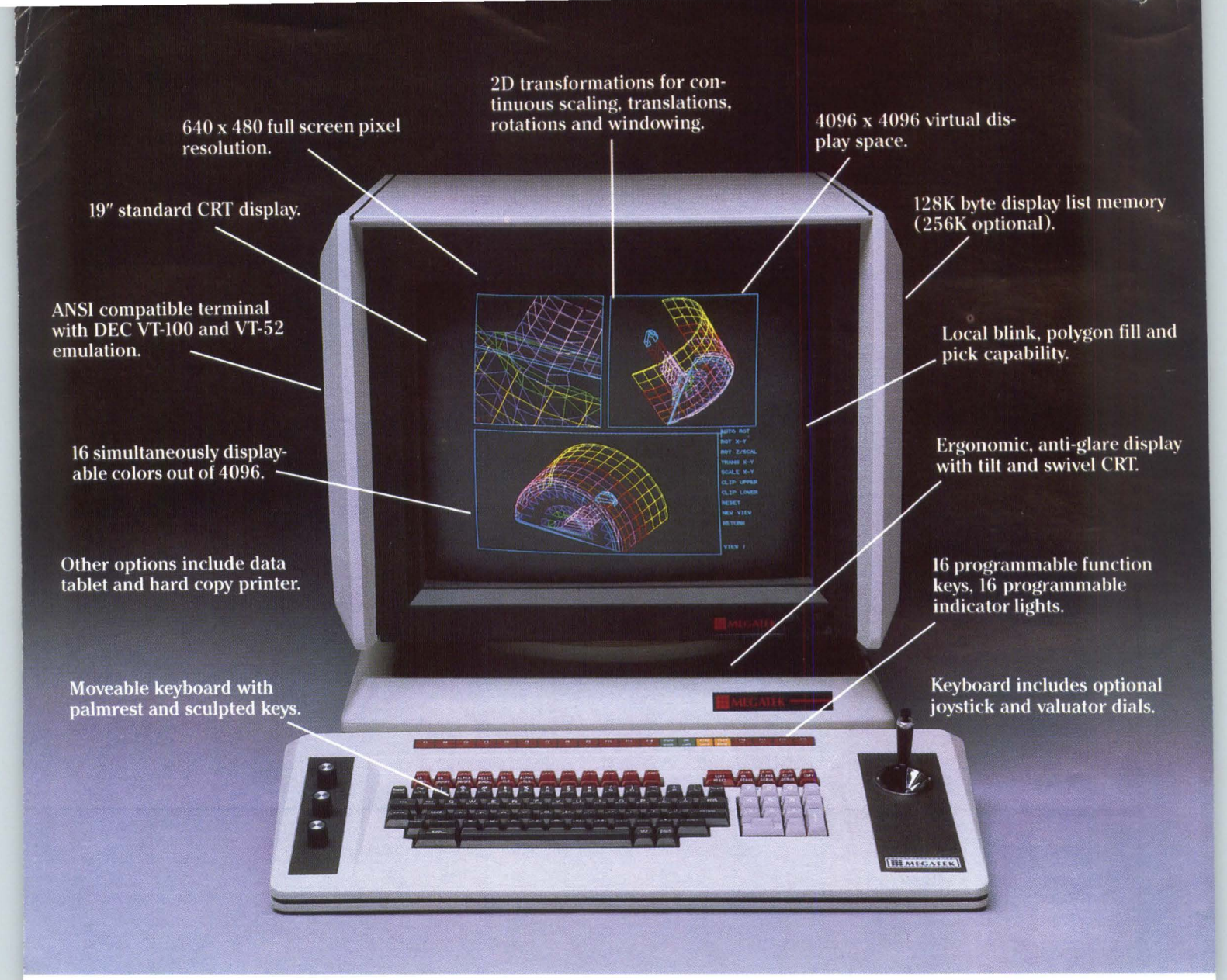
COMPUTER DESIGN

THE MAGAZINE OF COMPUTER BASED SYSTEMS



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SPECIAL REPORT: MASS STORAGE TECHNOLOGY



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*Thaumaturgy (thô´ma tûr jē), n., the performance of miracles.

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CIRCLE 1

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28 of these 109 perform an average seek in 30 milliseconds or less.

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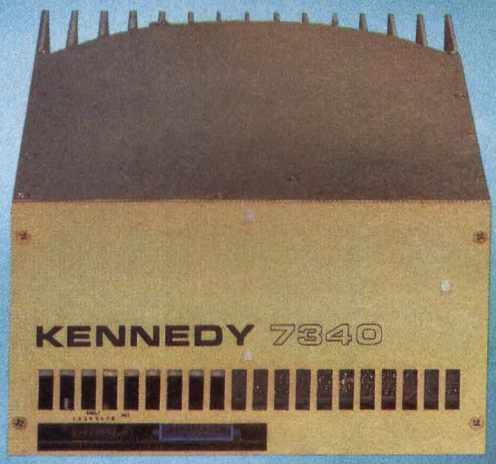
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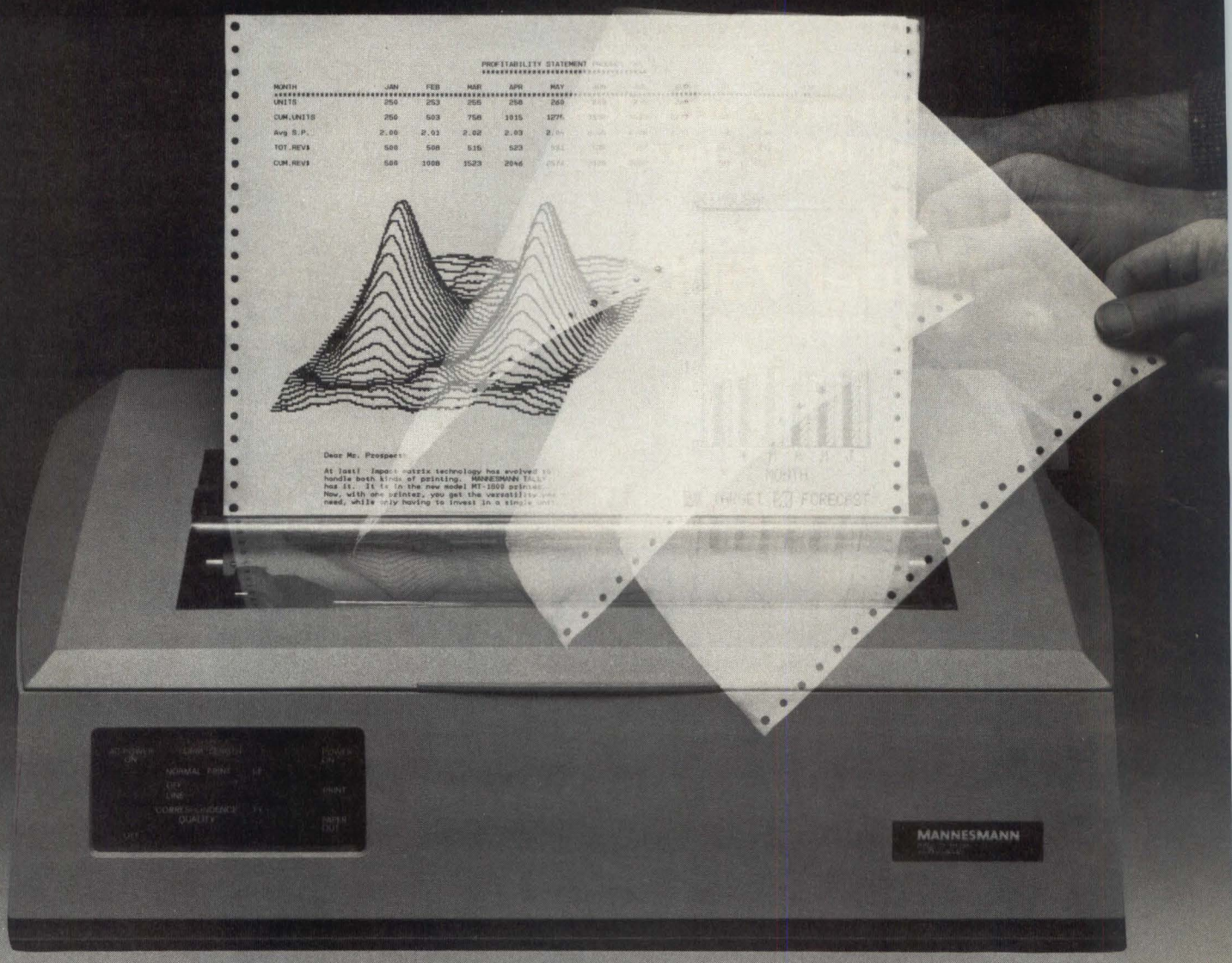
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CIRCLE 2

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For increased productivity, the MT 1800 has the Quick Tear option for immediate dispatch of the printed form. And for letterhead mailings, use Micro Tear continuous forms business stationary with the Quick Tear and benefit from the inherent speed and reliability of tractor feed operation.

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CIRCLE 3

UP FRONT

Seen through the snow at Electro and Mini/Micro

Two companies, NCR Corp's Microelectronics Div and Xicor, announced their versions of 5-V only nonvolatile random access memories. NCR's 52212 is a 1K-bit device organized in a 256-word by 4-bit array with a duplicate EEPROM for backup. Typical access time is 200 ns; maximum access times are 300 and 450 ns, respectively, for commercial and military versions. At least 10^4 possible store cycles with a 1-yr data retention are guaranteed. Each store cycle requires 8 ms. Xicor's 256-bit device, the X2444, communicates with single-chip microcontrollers via a synchronous serial bus that requires only three I/O lines. This device is actually an EEPROM overlaid bit for bit on a static RAM. Fewer than 100 bytes of nonvolatile control code need be stored in the controller. A "sleep" mode, which turns off power to the RAM, reduces current well below the 15-mA active level.

RCA Solid State has signed a licensing agreement with LSI Logic Corp for RCA to alternately source the LSI 5000 logic array series. The LSI 5000 arrays are fabricated in a 3-micron double-layer metal HCMOS technology and range from 880 to 6000 gates in complexity. They exhibit Schottky TTL speeds of 2.5-ns propagation delay for a typical 2-input NAND gate that has two loads. While the companies' processes are different, RCA claims that the end products will be 100% compatible, thus providing customers with a true second source. Prototype delivery is scheduled for the fourth quarter of 1983.

Gould, Inc Design & Test System Div, and Intermetrics, Inc Software Products Div, introduced two cofunded products, InterC and InterPas, respectively C and Pascal cross-compilers for the 8086 and 68000 microprocessors. Both run on VAX and PDP-11 minicomputers and are intended specifically for the embedded microprocessor systems builder.

A Multibus to IEEE 488 interface board from National Instruments enables transfer of data between the two buses. The GPIB-796 supports DMA transfer at 500k-bytes/s speeds in data block lengths up to 64K bytes. Burst timeout is programmable from 3 to 400 μs. The board provides choice of 8- or 16-bit I/O port addressing and implements 24-bit Multibus addressing.

Crydom's 8203 temperature controller, intended for use with either video terminal or computer, uses simple English commands recognizable by factory personnel. Eight temperature input channels connected to transducers provide resolution of 0.25 °C over a span of 60 °C, user adjustable from −55 to 150 °C. The controller functions with any D2W solid state relay or MP series output module.

Features of Hilevel Technology's DS370 Emulyzer include 16 levels of trigger/trace control with eight independent patterns per level as well as symbolic debugging with user defined mnemonics, time measurements for performance analysis, multiple dynamic user defined formats for memory emulation, and 64k breakpoints. Trace memory is 80 bits wide and 4K deep.

Boschert Inc introduced its ET50-3601 triple-output switching power supply as the first of its Eurocard format units. The 50-W supply fits 3U racking systems and provides 5 V at 5 A and 12 V at 0.7 A. It meets VDE 0806, IEC 380, UL478, and CSA C22.2 safety requirements; an rfi filter meets FCC and VDE 0871 Level B noise specs. A power fail detect circuit warns of power failure at least 5 ms before the outputs drop out of regulation.

UP FRONT

Pretriggers

NCC will be the platform for the unveiling of the first products from Gould/Distributed Systems Div for the computer systems business. Products from the recently announced Nashua, NH division start at the PC1000, an 8086 based sub-$5000 professional microcomputer and range up to the PC5000 mega-micro, which can reach into the $125,000 class, fully expanded. The entire group supports an Ethernet LAN in almost any conceivable combination of clusters and is fully integrated into the Gould/SEL Concept mainframe line.

CMOS has been pushed closer to being the technology of choice for VLSI by CHMOS-D III, according to Intel Corp. Its 70-ns 64K DRAM boasts very thin gate oxides, as low as 150 Å, for greater resistance to soft errors, as well as significantly reduced power consumption.

Timing accuracy up to 500 ps with ±10-ps resolution is provided by the HP 1965A, a gated universal counter module for Hewlett-Packard's HP 1980A/B oscilloscope measurement system. The fully HP-IB programmable expansion module also adds gated-timing frequency, period, time interval, and events measurement capabilities.

Non-daisywheel OEM printers introduced by Diablo Systems include the Series 200 electronic printing machine, a plain paper thermal transfer unit with a resolution of 200 dots/in, and the Series C ink jet printer, which has a resolution of 120 dots/in and can print in any of six colors and black.

A migration path for existing Z80 software to grow into higher performance systems with memory address spaces up to 16M bytes is provided by a Zilog family of microprocessors. The Z800 family features onchip memory management system/user modes of operation, and onchip peripherals including DMA, UART, clock oscillators, and programmable refresh circuitry. Execution speeds are supported at up to 5M instructions/s.

High speed digital processing chips that execute 5M instructions/s have been announced by Texas Instruments. Cycle time is 200 ns. Applications are expected in image processing, speech recognition and synthesis, and instrumentation control.

Switching and interface circuitry for fault-tolerant systems, the iAPX 43204 bus interface unit and the 43205 memory control unit, have been introduced by Intel. The devices detect failures and switch to a redundant processor, bus, or memory.

A family of 5¼" hard disk drives with maximum unformatted capacity of 380M bytes is being announced by Maxtor Corp. Use of the company's enhanced small disk interface permits a 10M-bps data transfer rate between the disk and its controller, enabling an increase in recording densities of 14,873 fcpi. A run-length limited encoding scheme gives an effective bit density of 22,310 bpi. The EXT-4000 disks have a data separator onboard, rather than in the disk controller, and can transfer data to the controller using NRZ coding.

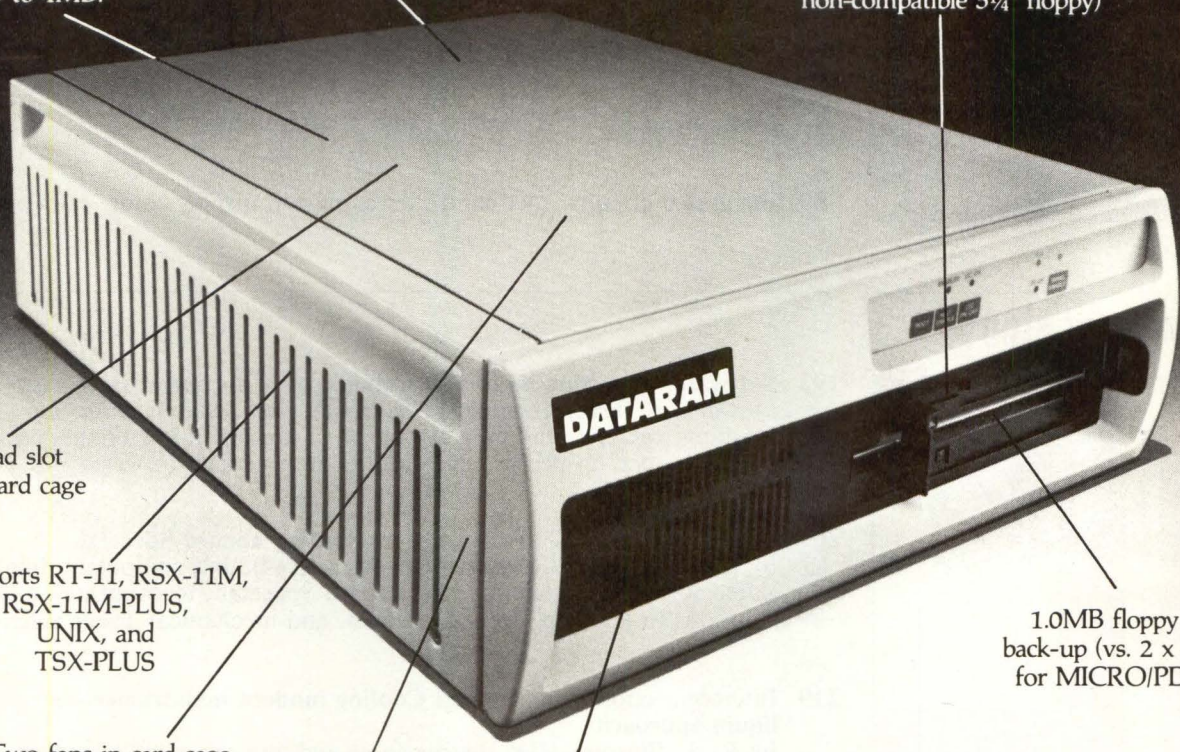
Dual processors in general purpose microcomputers from Cromemco provide access to a large number of software application packages. The 68000 and Z80A CPUs use the UNIX based CROMIX-D operating system.

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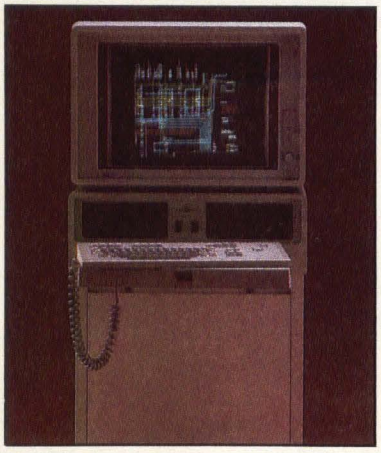
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CIRCLE 4

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COMPUTER DESIGN®

System technology



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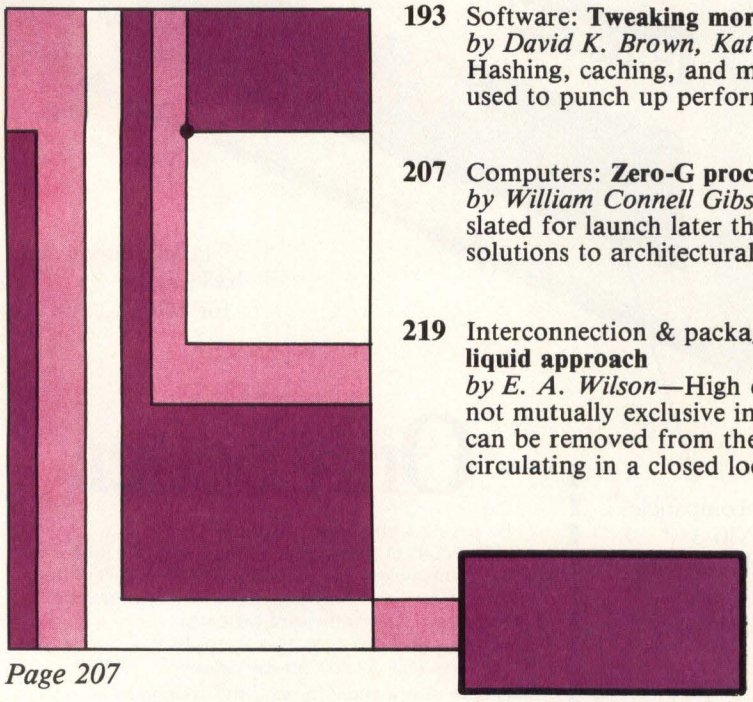
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System design



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by David K. Brown, Kathryn Strutynski, and John H. Wharton—Hashing, caching, and memory blocking are just a few of the techniques used to punch up performance in the latest version of CP/M.

207 Computers: **Zero-G processing—computing aboard Spacelab**
by William Connell Gibson—Rugged space-bound computers, like those slated for launch later this year aboard Spacelab, incorporate unique solutions to architectural, radiational, and mechanical design dilemmas.

219 Interconnection & packaging: **Cooling modern mainframes—a liquid approach**
by E. A. Wilson—High density logic and low operating temperatures are not mutually exclusive in modern mainframe computers. In fact, heat can be removed from the densest logic assemblies by ordinary tap water circulating in a closed loop cooling system.

NCC '83

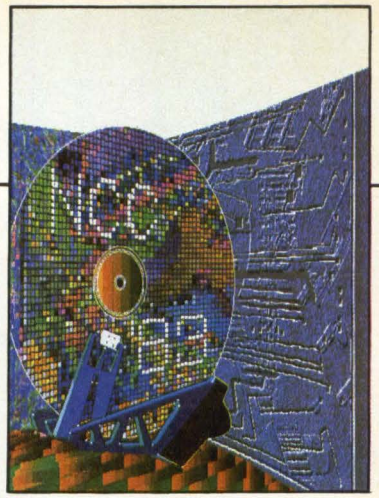


62 Technical sessions and product expositions at the 1983 National Computer Conference are expected to demonstrate the burgeoning interdependence between computer applications and communications technology. *Computer Design* previews many products to be introduced at the Anaheim Convention Center for those planning to comb the 320,000-ft^2 exhibition.

Vol 22, No 6
May 1983

Special report on mass storage technology

227 To satisfy the seemingly insatiable appetite of computer systems, mass storage systems continue to boost performance, cut costs, and increase reliability. Therefore, this month's "Design Frontier" report explores the expanding world of mass storage technology. Competing microfloppy drives show a state of confusion that will remain until a standard can be established. Managing storage for complex clustered systems presents another level of problems dealt with in the report. Also considered are the strategies that can be used to supply the all-essential backup function for mass storage units of all kinds.



This month's cover, "Disk Technology," was created by Mark Lindquist on the Digital Effects Video Palette III and is based, in part, on pictures supplied by Shugart Corp (Sunnyvale, Calif).

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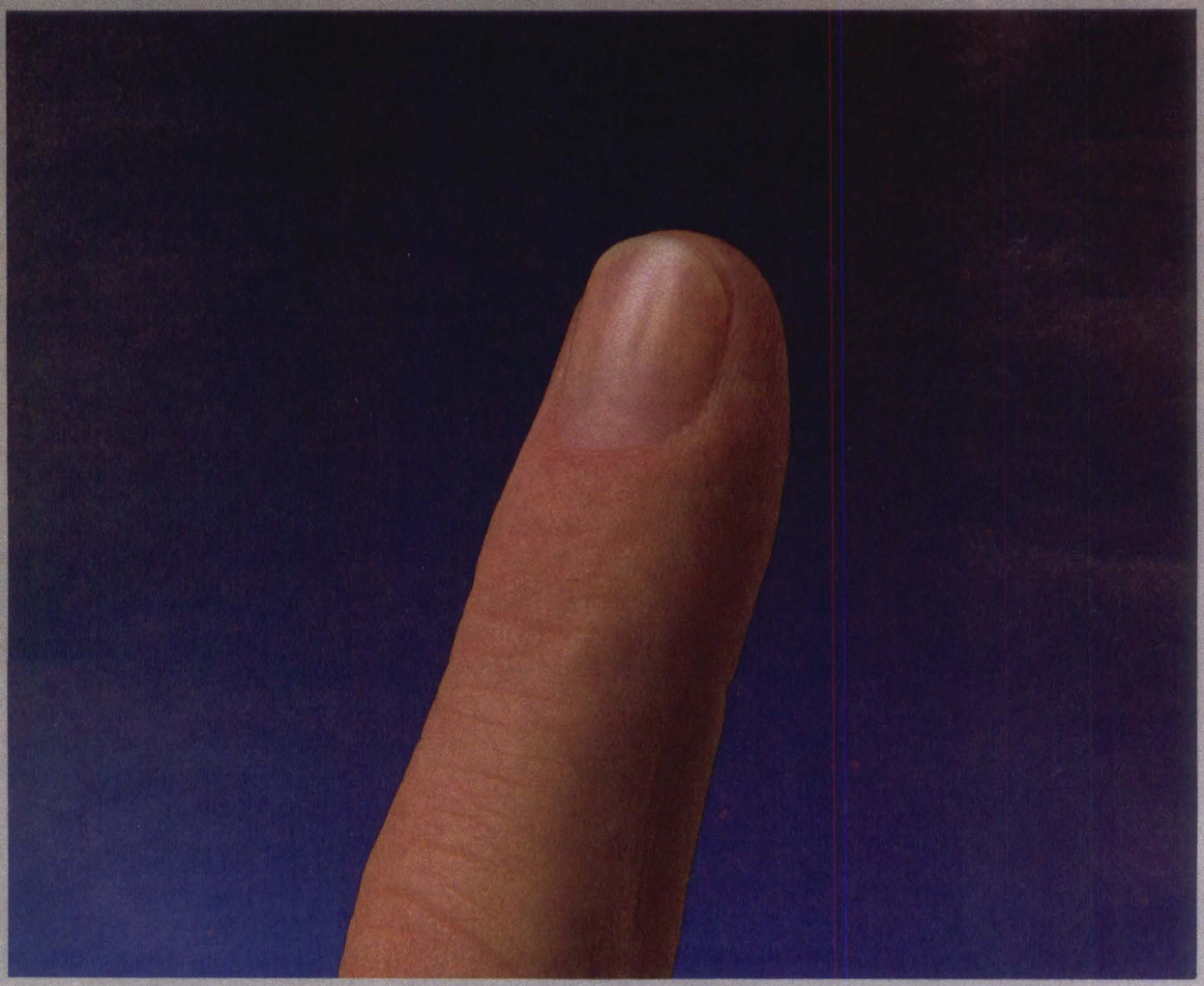
Designers' preference survey*

295 **Components, assemblies & power supplies**

*Appearing in Domestic issues only

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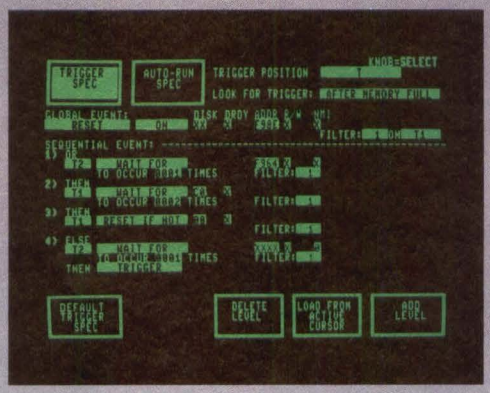
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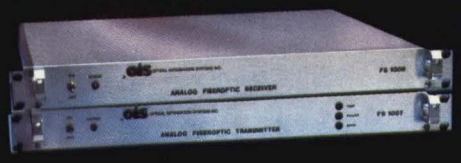
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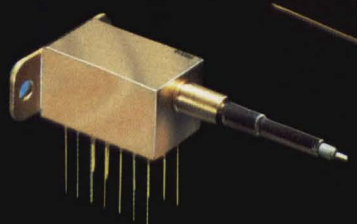
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CIRCLE 7



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CIRCLE 8



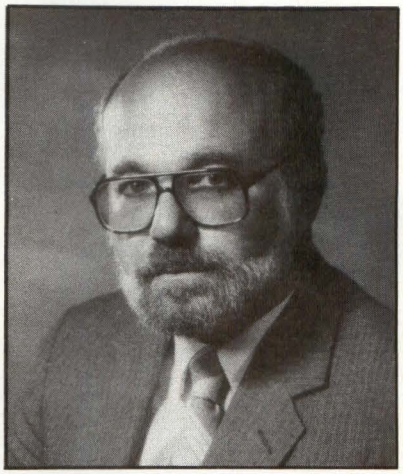
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WE'VE SEEN THE CAD— NOW LET'S SEE THE CAE



All senior engineers dream about what a personal professional computer might do for them. But, it's doubtful that many engineers place as high a value on word processing and spread sheets as the vendors do. Some of the more recent announcements, particularly in the 16-bit arena, have targeted a product area popularly referred to as the engineering workstation. Priced at the same level as the last generation's personal computers, these systems handle graphic and alphanumeric data and are presumably intended for professional engineering use.

One wonders, however, whether some of these systems aren't primarily aimed at computer aided drafting rather than design or engineering. In some engineering applications, the benefits of a personal drafting tool are quite obvious—but, essentially, drafting is not a major engineering function. Drafting bears the same relationship to senior engineers that word processing does to other professionals—it is a duty that less senior staff members normally perform. In much the same way, printed circuit board layout is a drafting function that requires a certain amount of creativity, but it is, nonetheless, another form of word processing. Thus, it is usually not performed by a senior engineer. Furthermore, although there is no question that professional engineers are likely to make better use of spread sheets than average business professionals, performing these calculations is not the major part of what senior engineers do for a living.

Because of these recent developments and resultant concerns, our July issue will feature a staff report on engineering workstations. Based on our research so far, we are likely to cover many new, inexpensive high performance products that are increasingly easy to use—but, how they are used is what really counts. Normally, when we do a survey report, we try to contact every company that makes or purports to make products that exemplify the technology discussed. Our editors then sift and sort the information down into a report.

This time, in addition to the research our editors normally do, I would like to involve you, the readers, in the process. Our staff has almost finished the report and—the U.S. mail being what it is—we couldn't possibly get feedback from you in time to include it. However, if you will take the time to write us, if only a brief line written in the Editorial Comments box on our Reader Inquiry Card, we will incorporate these comments into a later report.

What we would like to know is this: as the prospective user of these engineering workstations, what qualities would you like to see that will enhance your abilities as a creative engineer? Perhaps, you already use a professional computer with your own software as an engineering tool, or have purchased software we don't know about—whatever your experience, please tell us about it.

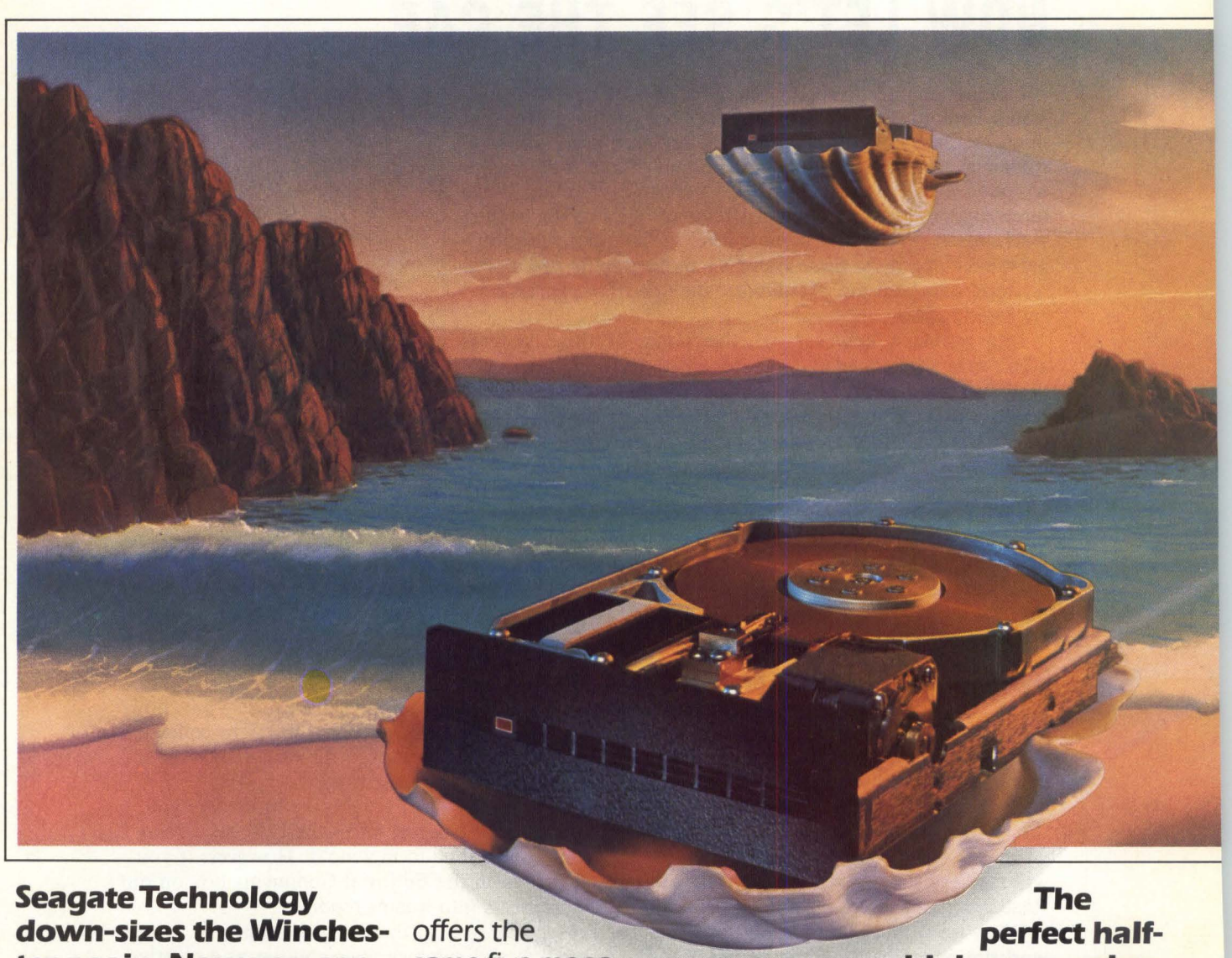


Saul B. Dinman
Editor in Chief

Best Technical Article of the Month—October
"Expanding the Z80's Memory"
Lan Nguyen, Zilog, Inc

This article will now compete with other monthly winning articles for the 1982 editorial excellence award.

5Mb on the half-



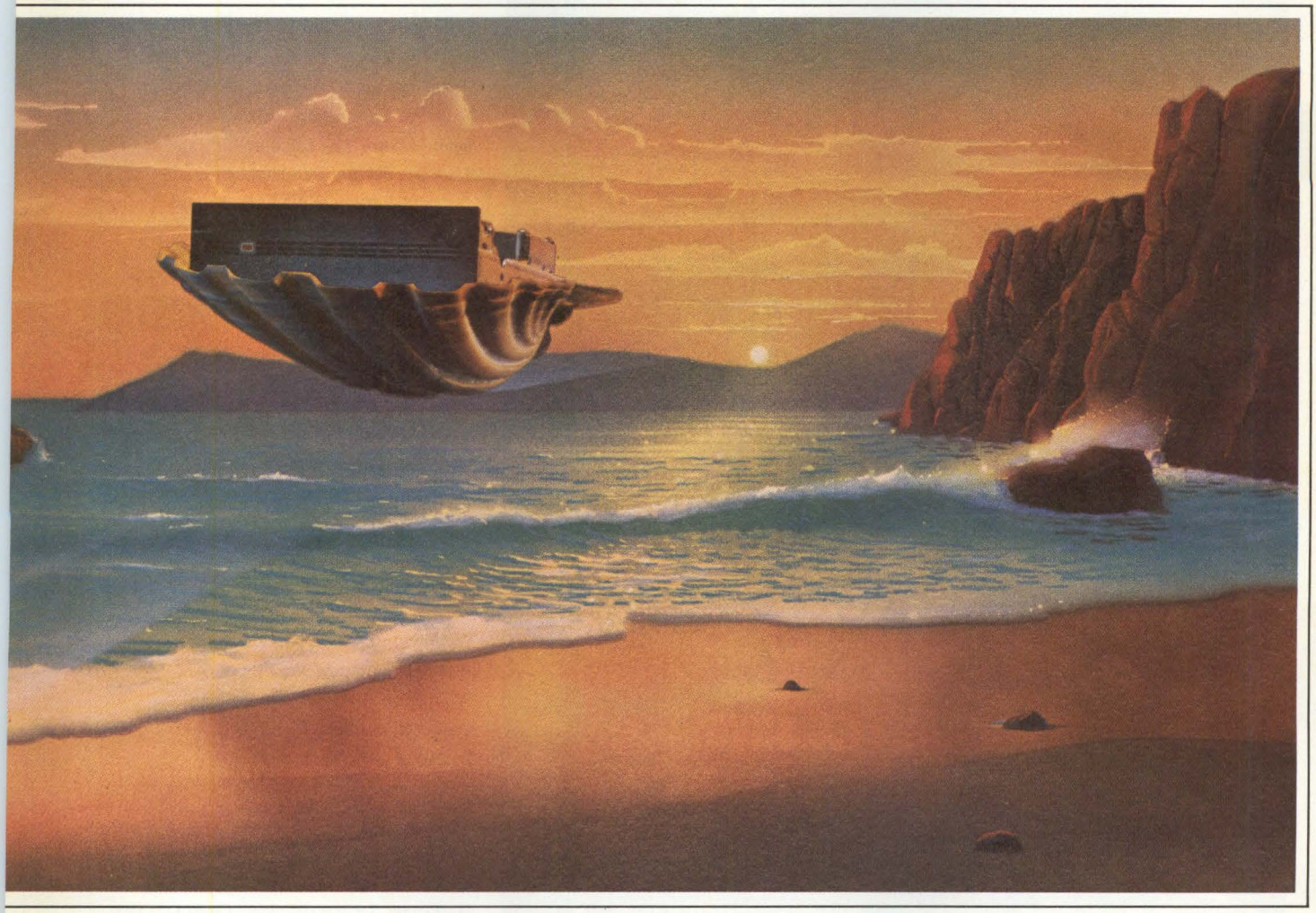
Seagate Technology down-sizes the Winchester again. Now you can store five megabytes on-line in half the height of our standard 5¼" Winchesters.

Our new half-high ST206 offers the same five megabytes (formatted) of storage capacity in a new, low-profile design. And we've included rugged plated media for even greater reliability.

The perfect half-high companion.

Now you can fit two half-high discs, our new ST206 and any half-high minifloppy, in the same space as our standard Winchester. The ST206 is

shell, from Seagate.



the perfect size for your new, low-profile system designs. It's also rugged enough for portable applications.

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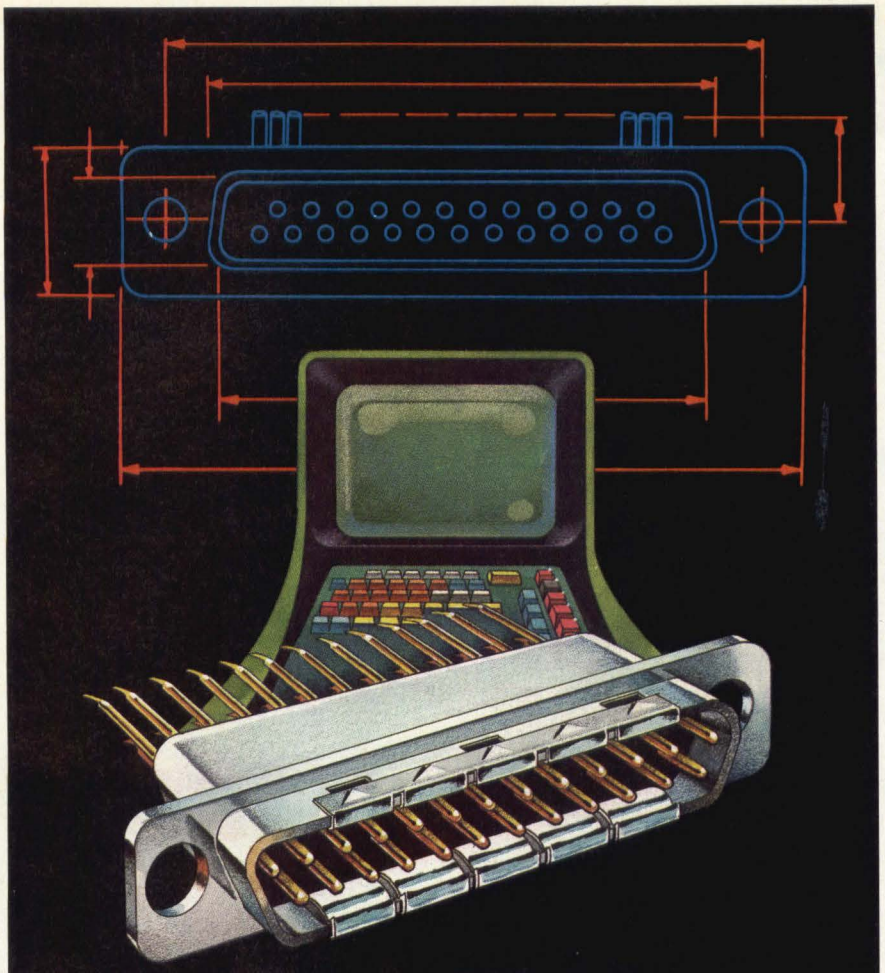
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CIRCLE 11



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CIRCLE 13

CONFERENCES

JUNE 13-16—Internat'l Conf on Computer Architecture, Stockholm, Sweden. INFORMATION: H. W. Lawson, Jr, Linkoping Univ, S-581 83, Linkoping, Sweden

JUNE 14-16—Ohmcon, Cobo Hall, Detroit, Mich. INFORMATION: Jerry Fossler, Electronic Conventions, Inc, 8110 Airport Blvd, Los Angeles, CA 90045. Tel: 213/772-2965

JUNE 19-23—Computer Vision and Pattern Recognition (formerly Pattern Recognition and Image Processing) Conf, Crystal City Hyatt, Arlington, Va. INFORMATION: IEEE Computer Society, PO Box 639, Silver Spring, MD 20901. Tel: 301/589-8142

JUNE 19-22—Internat'l Conf on Communications, Sheraton-Boston Hotel, Boston, Mass. INFORMATION: C. William Anderson, New England Telephone & Telegraph, 350 Cochituate Rd, Framingham, MA 01701. Tel: 617/879-9000

JUNE 26-30—NCGA, McCormick Pl, Chicago, Ill. INFORMATION: Nancy LeFebvre, Nat'l Computer Graphics Assoc, 8401 Arlington Blvd, Fairfax, VA 22031. Tel: 703/698-9600

JUNE 27-29—Design Automation Conf, Fontainebleau Hilton, Miami Beach, Fla. INFORMATION: Charles E. Radke, IBM Corp (ZIP-47A), Rte 52, Hopewell Junction, NY 12533. Tel: 914/897-4682

JUNE 27-29—Localnet, New York, NY. INFORMATION: Online Confs Ltd, Argyle House, Northwood Hills, HA6 1TS, Middx, U.K. Tel: Northwood 09274/28211; 44/9274/28211 (internat'l)

JULY 11-13—Computer Simulation Conf, Hyatt Regency Vancouver, Vancouver, BC, Canada. INFORMATION: Society for Computer Simulation, PO Box 2228, La Jolla, CA 92038. Tel: 714/459-3888

JULY 25-29—SIGGRAPH (Assoc for Computing Machinery Special Interest Group on Computer Graphics), Detroit, Mich. INFORMATION: SIGGRAPH Conf Office, 111 E Wacker Dr, Chicago, IL 60601. Tel: 312/644-6610

AUG 9-11—World Congress on the Human Aspects of Automation, Univ of Michigan, Ann Arbor, Mich. INFORMATION: Pat Van Doren, Technical Activities Dept, Society of Manufacturing Engineers, One SME Dr, PO Box 930, Dearborn, MI 48128. Tel: 313/271-1080 X369

AUG 23-26—Internat'l Conf on Parallel Processing, Shanty Creek Lodge, Bellaire, Mich. INFORMATION: IEEE Computer Society, PO Box 639, Silver Spring, MD 20901. Tel: 301/589-8142

SEPT 13-15—Autofact Europe, Palexpo Conf and Exhibition Ctr, Geneva, Switzerland. INFORMATION: Automated Systems Assoc, Society of Manufacturing Engineers, One SME Dr, PO Box 930, Dearborn, MI 48128. Tel: 313/271-1500

SEPT 13-15—Federal Computer Conf, Washington Conv Ctr, Washington, DC. INFORMATION: Federal Education Programs, PO Box 368, Wayland, MA 01778. Tel: 617/358-5181; 800/225-5926 (outside Mass)

SEPT 13-15—Midcon, O'Hare Expo Ctr and Hyatt Regency O'Hare, Rosemont, Ill. INFORMATION: Jerry Fossler, Electronic Conventions, Inc, 8110 Airport Blvd, Los Angeles, CA 90045. Tel: 213/772-2965

SEPT 13-15—Mini/Micro-Midwest, O'Hare Expo Ctr, Rosemont, Ill. INFORMATION: Jerry Fossler, Electronic Conventions, Inc, 8110 Airport Blvd, Los Angeles, CA 90045. Tel: 213/772-2965

SEPT 13-15—Peripherals, Moscone Ctr, San Francisco, Calif. INFORMATION: Cahners Expo Group, Cahners Plaza, 1350 E Touhy Ave, PO Box 5060, Des Plaines, IL 60018. Tel: 312/299-9311

SEPT 13-15—WPOE (Word Processing and Office Environment Show and Conf), San Jose Conv Ctr, San Jose, Calif. INFORMATION: Cartlidge & Assocs, Inc, 4030 Moorpark Ave, Suite 205, San Jose, CA 95117. Tel: 408/554-6644

SEPT 19-23—IFIP (Internat'l Federation for Information Processing) World Computer Congress, Paris, France. INFORMATION: Philip H. Dorn, Dorn Computer Consultants, Inc, 25 E 86th St, New York, NY 10028. Tel: 212/427-7460

SEPT 20-21—Data Storage, Marriott Hotel, Santa Clara, Calif. INFORMATION: Cartlidge & Assocs, Inc, 4030 Moorpark Ave, Suite 205, San Jose, CA 95117. Tel: 408/554-6644

SEPT 26-29—Compcon Fall, Mariott Gateway, Crystal City, Arlington, Va. INFORMATION: IEEE Computer Society, PO Box 639, Silver Spring, MD 20901. Tel: 301/589-8142

WORKSHOPS

JUNE-JULY—Personal Computer Interfacing and Scientific Instrument Automation, various cities and dates. INFORMATION: Linda Leffel, C.E.C., Virginia Tech, Blacksburg, VA 24061. Tel: 703/961-4848

JUNE-JULY—Designing VLSI; Digital Processing; Digital Communications; Graphics, CAD/CAM & Robots; Hands-on UNIX; Microprocessors; Networks & Systems; and Software, various cities and dates. INFORMATION: Integrated Computer Systems, 3304 Pico Blvd, PO Box 5339, Santa Monica, CA 90405. Tel: 800/352-8251 (inside Calif); 800/421-8166 (outside Calif)

JUNE 1-2—Strategic Planning for Office Automation, Watergate Mall, Washington, DC. INFORMATION: Nancy Anderson, Micronet/KSI, 2551 Virginia Ave NW, Washington, DC 20037. Tel: 202/333-4800

JUNE 2-3—FCC Regulation of Computing Devices, JUNE 6-10—Workshop in Data Communications for Microcomputers, JUNE 20-24—Computer Communications Systems and Networks, AND JUNE 20-24—Microprocessors and Microcomputers: Theory and Applications, George Washington Univ, Washington, DC. INFORMATION: Douglas Green, Continuing Engineering Ed, George Washington Univ, Washington, DC 20052. Tel: 202/676-8512; 800/424-9773 (outside DC)

JUNE 20-23—Design of Realtime Microprocessor Systems, Univ of Wisconsin, Madison, Wis. INFORMATION: Robert Madding, Dept of Engineering and Applied Science, Univ of Wisconsin-Extension, 432 N Lake St, Madison, WI 53706. Tel: 608/263-7920

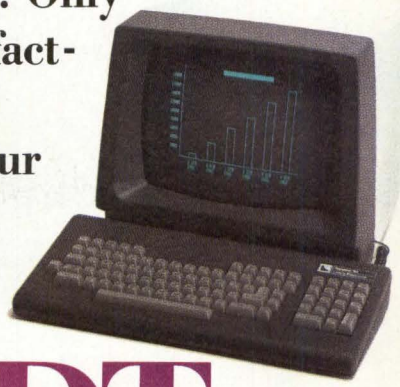
JULY 11-15—Hands-on Pascal Computer Programming, JULY 25-29—Reliability of Computer Software and Computing Networks, AND JULY 25-27—Computer Memory Systems, George Washington Univ, Washington, DC. INFORMATION: Douglas Green, Continuing Engineering Ed, George Washington Univ, Washington, DC 20052. Tel: 202/676-8512; 800/424-9773 (outside DC)

AUG 8-18—Data Communications, Iowa State Univ, Ames, Iowa. INFORMATION: Paul Bond, 131K Coover Hall, Iowa State Univ, Ames, IA 50011. Tel: 515/294-1526

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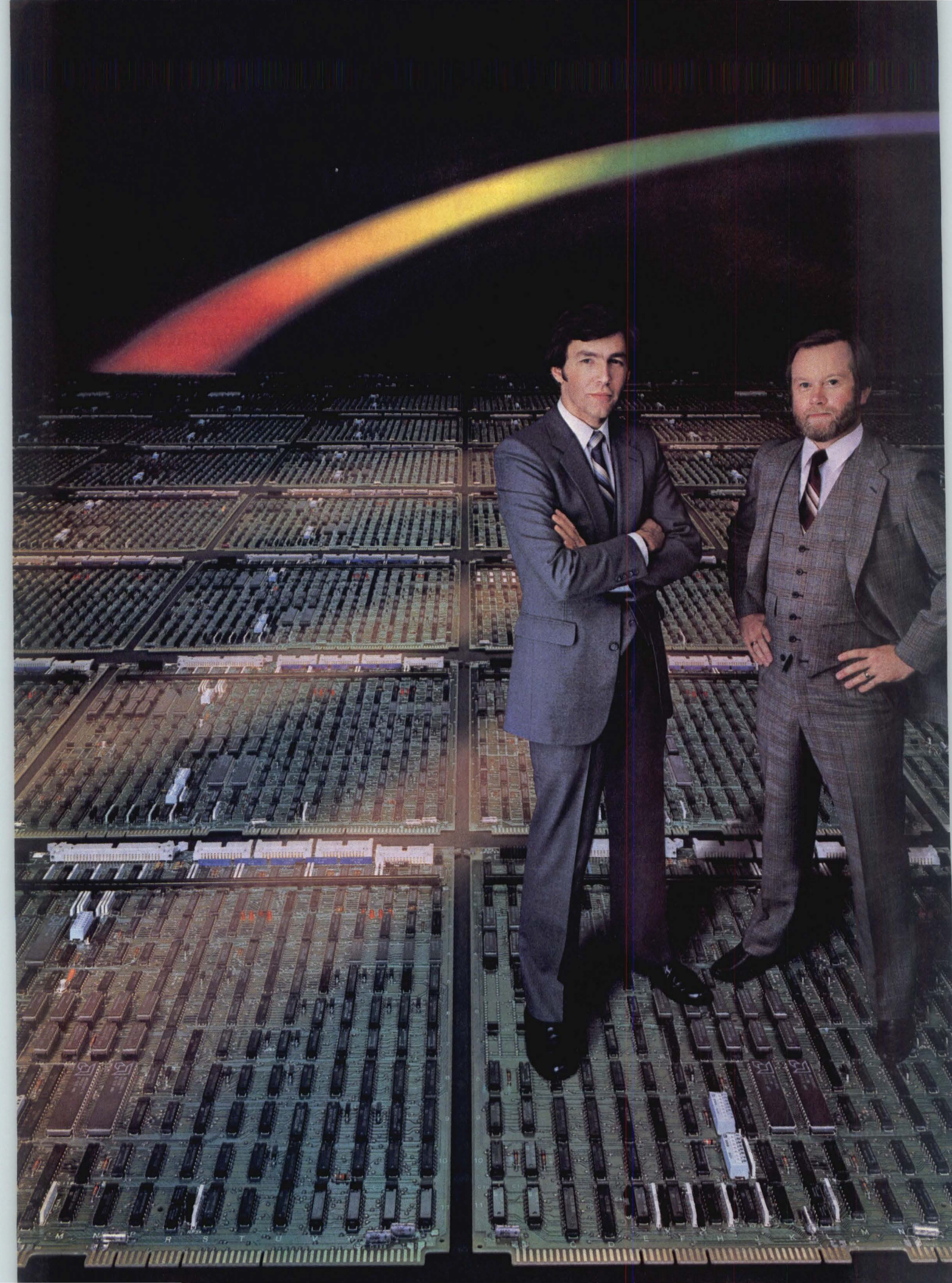


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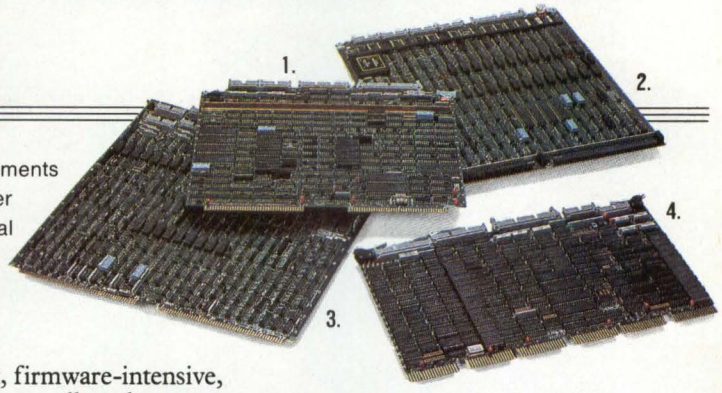
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CIRCLE 14



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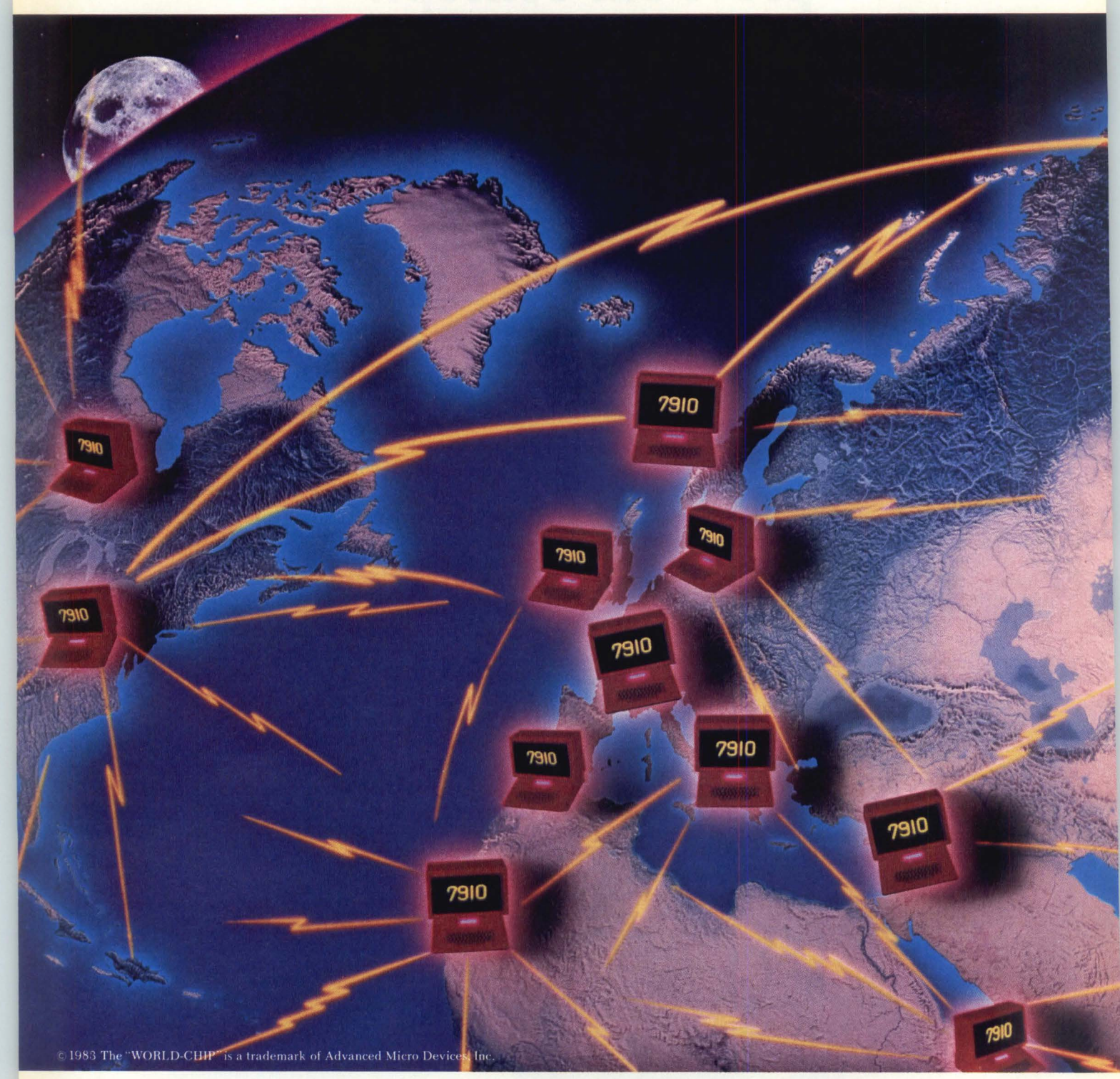
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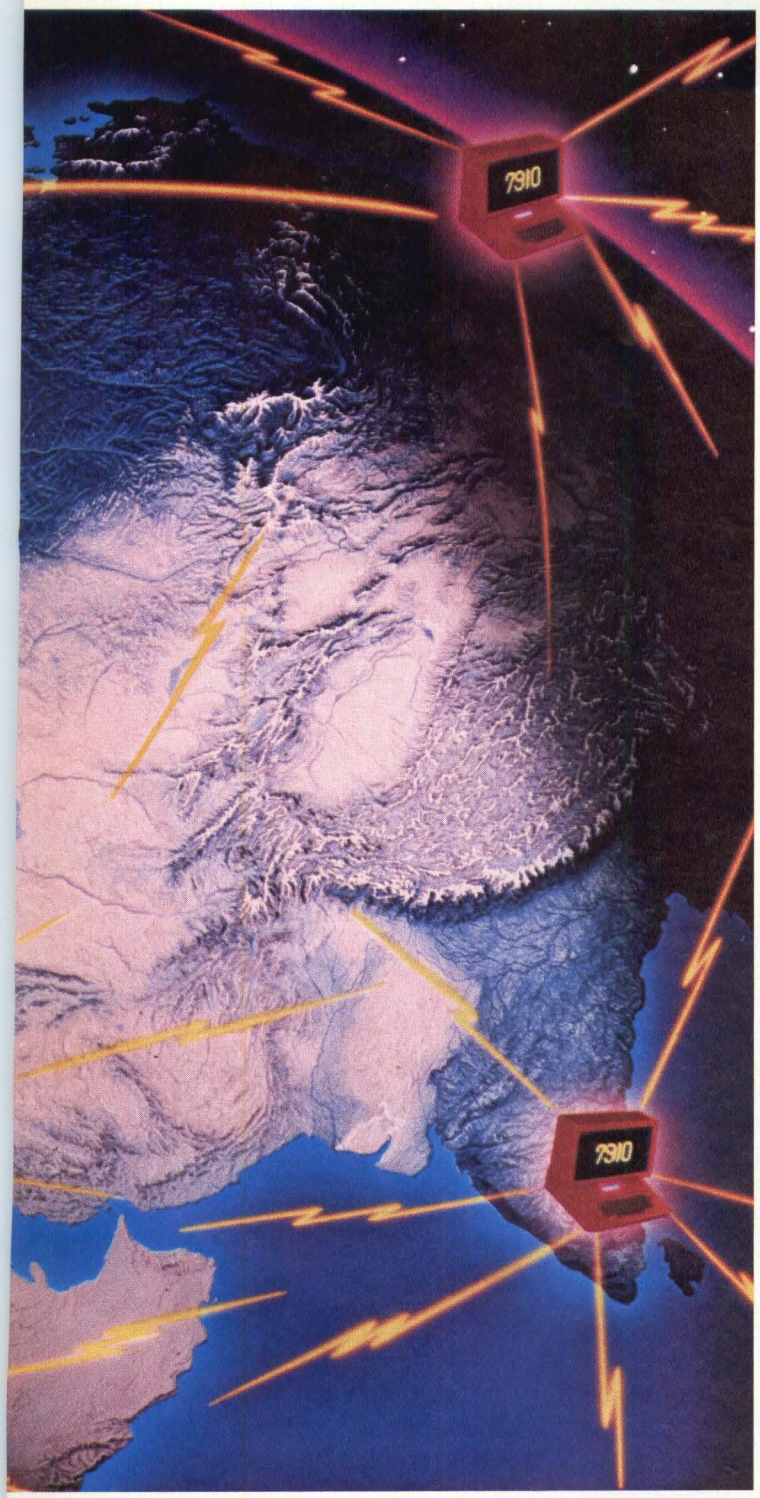
CIRCLE 15

THE CHIP HEARD



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CIRCLE 18

LETTERS TO THE EDITOR

The time is right

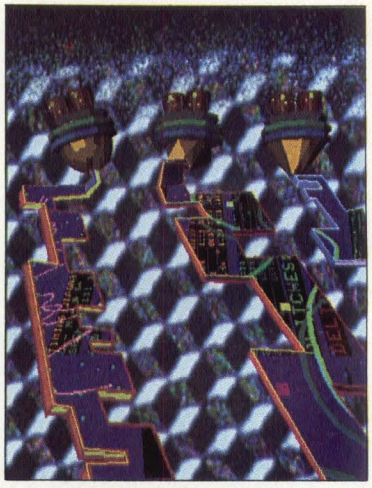
We at Source III read the article, "Changing Patterns in Custom ICs Alter Design Boundaries" by Douglas Eidsmore (Feb 1983, p 143) with great interest. We thought the article was well written, timely, and incisive. Having recently completed a 660-page report, "Gate Arrays Implementing LSI Technology," we appreciate the magnitude of effort required to generate an article such as yours.

We agree that "selecting a gate array vendor may be as crucial as creating the logic diagram," and this fact was part of our rationale for generating the gate array report. Our report presents a perspective on the semicustom industry supported by our having performed over 50 different implementations for a variety of semiconductor manufacturers. We strongly believe that the information contained in our report is invaluable to many of your readers and that they should be made aware of it.

Michael Magranet
Source III Inc
4320 Stevens Creek Blvd, Suite 195
San Jose, CA 95129

(To obtain a copy of the Source III report, contact Gene Selven, Electronic Trend Publications, 10080 N Wolfe Rd, Suite 372, Cupertino, CA 95014.)

Tektronix deserves credit



In Computer Design*'s table of contents for the April 5 issue, we failed to give credit to Tektronix Inc (Beaverton, Ore) for supplying photographs that were used as pictorial elements in that issue's cover. The completed cover, entitled "Timing Diagram," was created by Mark Lindquist and Joe Pasquale on the Digital Effects Video Palette III.*

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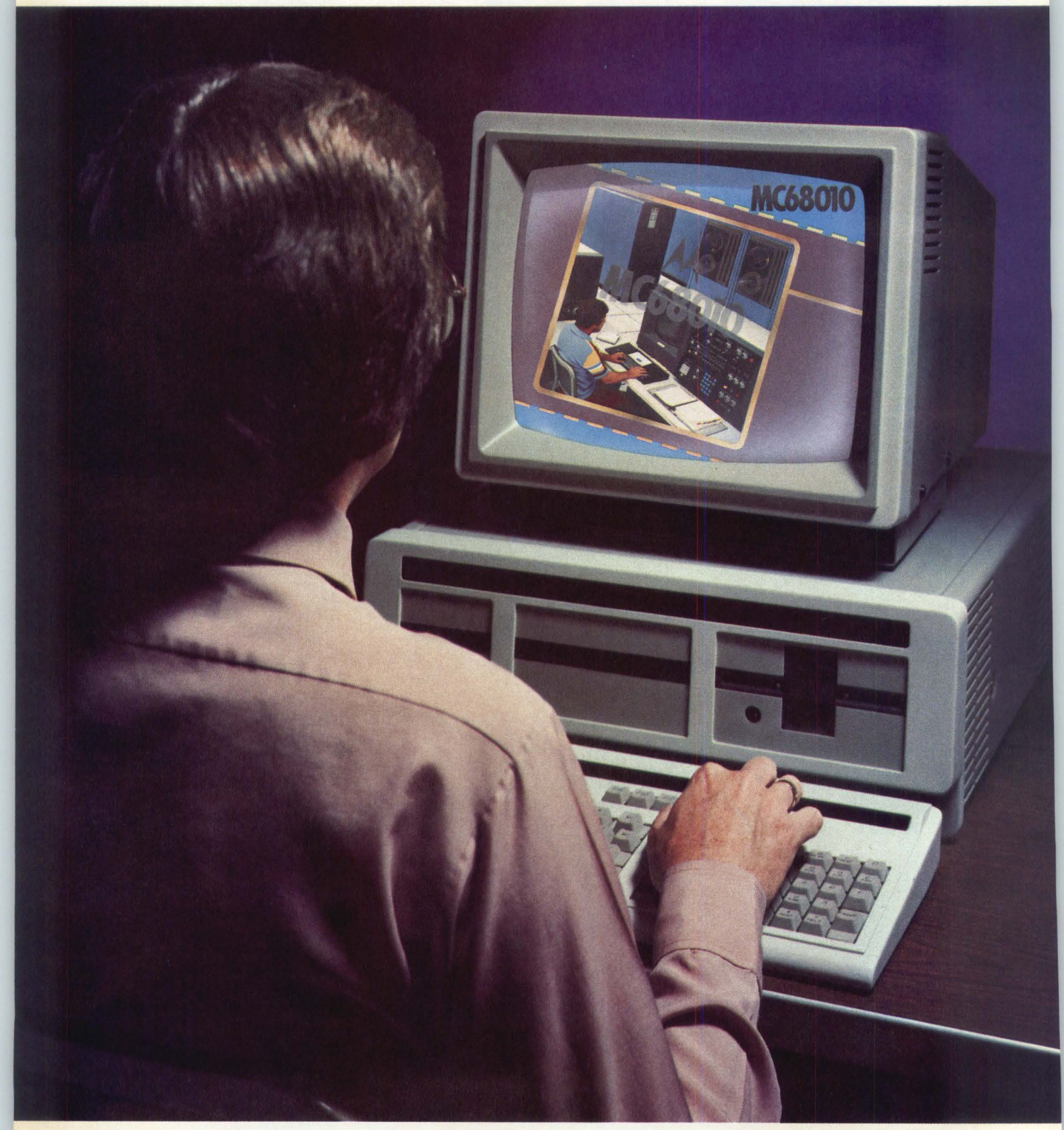
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CIRCLE 19

Motorola's virtual memory 16- mainframe capabilities for



bit MC68010 provides your microcomputer systems.

Now you can design powerful mainframe capabilities into your 16-bit microcomputers with the latest of Motorola's M68000 Family microprocessors.

The MC68010 fully supports virtual memory/virtual machine/ virtual I/O techniques in microprocessor based systems. This allows a system to operate as if it has many times the amount of physical memory it actually has, and makes it tolerant of faults.

Faults on any bus cycle can suspend any instruction and begin a controlled correction. The MC68010 doesn't try to predict faults; it responds to them intelligently. No segmented architecture offers these features.

The MC68010 tolerates failures of memory cards to make proper transfers, cleanly, regardless of cause.

It handles faults caused by hardware failure and the software protection faults that a memory manager finds.

MC68010 systems don't care whether faults are due to protection violation, non-existent memory, circuit failure, bad RAM or a watchdog timer. Even memory errors during important operating system procedures are tolerated routinely.

The MC68010 provides capabilities that once were confined to mainframe and minicomputer systems, and extends the leadership characteristics which have made the MC68000 so popular in new designs.

Applications programmers should love the MC68010.

Applications programmers don't have to code around, or even know about memory management. That's handled by the operating system. Many memory management techniques can be implemented, including demand paging, to make the bank-switching schemes of segmented architectures obsolete.

And, don't forget the MC68010 gives you the same 16 megabyte linear memory space as the MC68000.

For systems designed with error detection and correction (EDAC), the MC68010 helps you improve the design of systems with slower memories.

Enhanced instruction timing results in execution of MC68000 instructions up to 50% faster by the MC68010, at the same clock speed. The MC68010 runs all MC68000 user code identically, so your existing system is upgraded simply by placing the MC68010 in the MC68000 socket.

M68000 Family: 32-bit architecture makes it the only practical 8/16/32-bit migration path.

From the time the MC68000 was introduced it claimed the leader's mantle. One of the most significant reasons is its 32-bit architecture. It's not an 8-bit architecture stretched to 16, but 32 bits confined to a 16-bit bus. It's now also available in 8-bit form as the MC68008. That's a 32-bit architecture on an 8-bit bus. Full 32-bit power will soon be unleashed in the MC68020. From the MC68000 and MC68010, in both directions to the MC68008 and the MC68020, the M68000 family becomes the very definition of code compatibility . . . the only practical migration path along the 8/16/32-bit route.

Advanced tools assist fast, accurate system development.

Advanced MC68010 support is provided by the EXORmacs™ system; the first 8-/16-/32-bit multiuser development system.



An MC68010 Macro Assembler that runs on the EXORmacs will be augmented by the user-friendly HDS-400 Hardware/Software Development Station, which will provide real-time emulation to 8 MHz with no wait states.

When you need a variety of logic analysis and system performance histogram features, the Bus State Analyzer adapts to the MC68010 through a unique personality module.

Basic and C will soon be offered with existing Pascal and Fortran compilers, and symbolic debug is available. A broad and rapidly expanding base of development and applications software also is available from independent, third-party vendors.

M68000 family peripherals, memories, discretes, linear and logic meet your broad system needs.

M68000 MPUs are supported by a growing family of Motorola-developed peripherals. Contributions from our worldwide major second sources are adding even greater breadth and depth to the family.

Motorola memories from ROMs and PROMs to Static RAMs and state-of-the-art dynamic RAMs are available in chip, board or box form. And, Motorola is one of the few suppliers dedicated to bubbles.

Our discrete products are legendary for breadth of line and quality. Every significant logic form is available, and the Motorola linear line is among the world's leaders.

For direct M68000 Family assistance, call your local Motorola office or distributor. For information on the MC68010, send to Motorola Semiconductor Products Inc., P.O. Box 20912, Phoenix AZ 85036.

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Peripherals upgrade color graphics systems

A family of upwardly compatible color graphics products that span a wide range of functions has been introduced by Tektronix Corp. Included in the series are three low cost color terminals, a high end, high resolution color graphics terminal, and a low cost color copier. In addition, a graphics processing unit adds standalone graphics computation capabilities.

Highlight of the series is the 4115 terminal that Tektronix is adding to its 4110 graphics terminal line. The 4115 boasts a color raster scan display of 1280 x 1024 pixels, and a 32-bit coordinate space stores graphics. Up to 800K bytes of user RAM can be used to store a display list located anywhere within that 4G x 4G coordinate area. Improved vector drawing at 50k short vectors/s and 1 μs/pixel lets the 4115 approach realtime pan and zoom operations. Area filling has likewise been sped up, and the terminal can fill at a rate of 10k small rectangles/s, where a small rectangle is defined as 25 x 25 pixels. For each pan, zoom, and fill operation, the terminal completely traverses and redraws the entire display list.

Like other 4110 series members, the 4115 has RS-232 serial communication capability up to 19.2k baud, but it also features a DEC VAX computer DMA channel that can transfer data up to 2000′ (610 m) at 1M byte/s.

One innovation soon to become an option on the 4115 is autoconvergence. Autoconvergence is an extension of digital convergence, which uses a feedback method to sense and dynamically control CRT convergence. Like digital convergence, autoconvergence stores rough convergence values in ROM and fine adjustment values in CMOS RAM; there are 256 convergence areas on the screen. But unlike digital convergence, which requires a human operator to enter the fine adjustment values, autoconvergence enters this data itself.

Sensors look through the rear of the CRT envelope at phosphor dots on the back of the shadow mask. Each beam from the delta gun is swept separately. Sensors feed values back to the convergence processor and RAM until each beam successfully illuminates each dot and the display is properly converged. According to Tektronix, less than 0.2-mm misconvergence over the entire display results.



The 4115 high resolution color raster terminal incorporates a 1280 x 1024, 60-Hz noninterlaced display, a 32-bit coordinate space, and a 1M-byte/s DMA channel.

The three low cost 4100 series terminals introduced are the 4105, the 4107, and the 4109. Their color display size and resolution are 13″ (33 cm) with 360 x 480 pixels; 13″ with 640 x 480 pixels; and 19″ (48 cm) with 640 x 480 pixels, respectively. This series provides a dialogue area for both the alphanumeric display and the graphics plane. The user can select the dialogue area size, up to eight colors for use in the dialogue area, and the eight colors used for graphics display. Assigning a transparent background to the dialogue area allows simultaneous alphanumeric and graphics display.

An upgrade and compatibility path is provided for systems using the 4100 terminals to provide 4110 series compatibility. Known as the 4170 Local Graphics Processing Unit, this computer is a standalone, 8086/8087 based unit with the CP/M-86 operating system and a FORTRAN compiler. In addition, it includes utilities and graphics programs such as Tektronix's Plot 10 Interactive Graphics Language.

The 4170 is primarily intended to act as a tool for interactive graphics applications in a host environment. Host data can be downloaded, interactively manipulated, and written back to the host to maintain compatibility with other high end Tektronix terminals. Thus, the system designer can select a mixture of graphics terminal capabilities for the specific graphics environment (ie, statistics, CAD/CAM, and project management) at optimal cost for the task, while maintaining a painless upgrade path.

Rounding out the graphics offering is a low cost ink jet color copier, the 4695. Plug compatible with the 4105 and 4107 terminals, this copier can place 120 dots/in both in horizontal and vertical directions. Four ink cartridges provide cyan, yellow, magenta, and black. They deposit four rows of dots on each pass of the ink jet head.

The ink is deposited by on-demand jets driven by piezoelectric crystals, and the head moves much like that of a bidirectional printer. In fact, the 4695 has an alphanumeric mode using a ROM based character set for printing text when needed (eg, from the dialogue area of a 4105 terminal).

Moreover, the 4695 is compatible with the 4100 series' color levels; the terminals' gray scale levels drive dithering algorithms in the copier to produce similar shades on the copy. In addition to roll-fed paper, manually fed cut-sheet paper can be used. Tektronix will also soon support transparencies on the 4695. **Tektronix, Inc**, PO Box 500, Beaverton, OR 97077. **Circle 310**

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CIRCLE 20

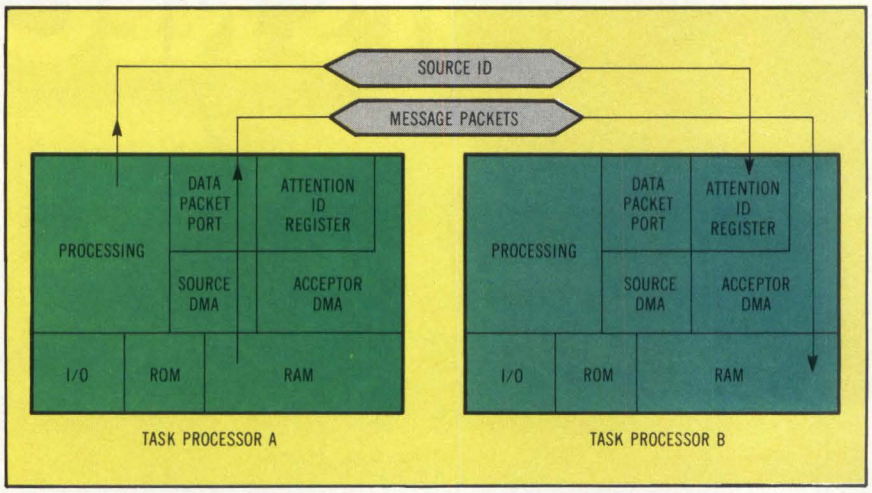
Plug-in modules support serial I/O protocols.

Metacomp's MPA-2000 communication controller lets users configure any of the four full-duplex DMA channels to handle various serial I/O protocols and electrical interfaces. A proprietary message passing scheme that overcomes shared memory limitations supports interprocessor communication on the Multibus.

Plug-in modules are key to the controller's flexibility. Logic to support specific protocols is separate from logic that supports electrical interfaces. Asynchronous and synchronous communication supports IBM Bisync or Digital Data Communication Message Protocol (DDCMP) character-oriented protocols, IBM SNA/SDLC, HDLC bit-oriented protocols, and high level disciplines like ADCCP and CCITT X.25 packet switching. Electrical interfaces for RS-232, RS-422/-423, and optical are included. Modules contain VLSI devices best suited to support the specific protocol or electrical interface implemented. These low profile devices save users from paying card-slot penalties.

With an onboard Intel iAPX-186 16-bit microprocessor, the controller offloads the host computer of serial I/O processing. Users can program up to 96K bytes of EPROM for proprietary routines and still access portions of the iRMX-86 operating system supported in the i80130 OSF module. Workspace is provided in 128K bytes of onboard dynamic RAM, with 16M bytes of offboard memory addressed using a page/segment scheme. Interrupt controllers, timers, and a low speed serial I/O port for debugging expand the controller's capabilities.

With configurable I/O ports, the MPA-2000 can go beyond serial communications. For example, the controller might act as a gateway between IBM SNA/SDLC synchronous networks and CCITT X.25 packet switched networks. In this case, the 16-bit processor would set up three buffers to accept input from one network, convert characters and control information, and transmit the processed message. According to the company, all three operations could occur simultaneously through multitasking routines embedded in the iRMX-86 firmware. User designed custom modules could expand the controller to act as a database processor. A custom Winchester disk controller/formatter module plugged into two of the four DMA channels would be sufficient, according to the company. The two remaining DMA channels could be used as serial I/O lines for support terminals.



Rather than relying on shared memory, the Metacomp MPA-2000 transfers messages from the source memory (task processor A) to the acceptor memory (task processor B). The source initiates a transfer by passing the source ID number to the acceptor's Attention ID register, generating an interrupt in task processor B.

In anticipation of these possibilities, the company developed a proprietary interprocessor communication scheme for use with its peripherals. MetaPaket is intended to overcome the limitations of current schemes such as shared memory, programmed message transfers, or single contiguous message blocks.

Shared memory techniques suffer from tradeoffs between fixed memory regions, memory management schemes, and message size. Programmed message transfers and contiguous message blocks need message management software that takes up multiple processor cycles. Current schemes also suffer from fragmented memory where blocks are either too small or too large to accommodate the message.

As a result, overall system throughput on the bus suffers. Overhead associated with the use of Multibus processor cycles to supervise message transfer, and arbitration delays associated with dual-ported RAMs, cause bus saturation. This occurs because current implementations often require multiple bus masters or onboard dual-ported RAM.

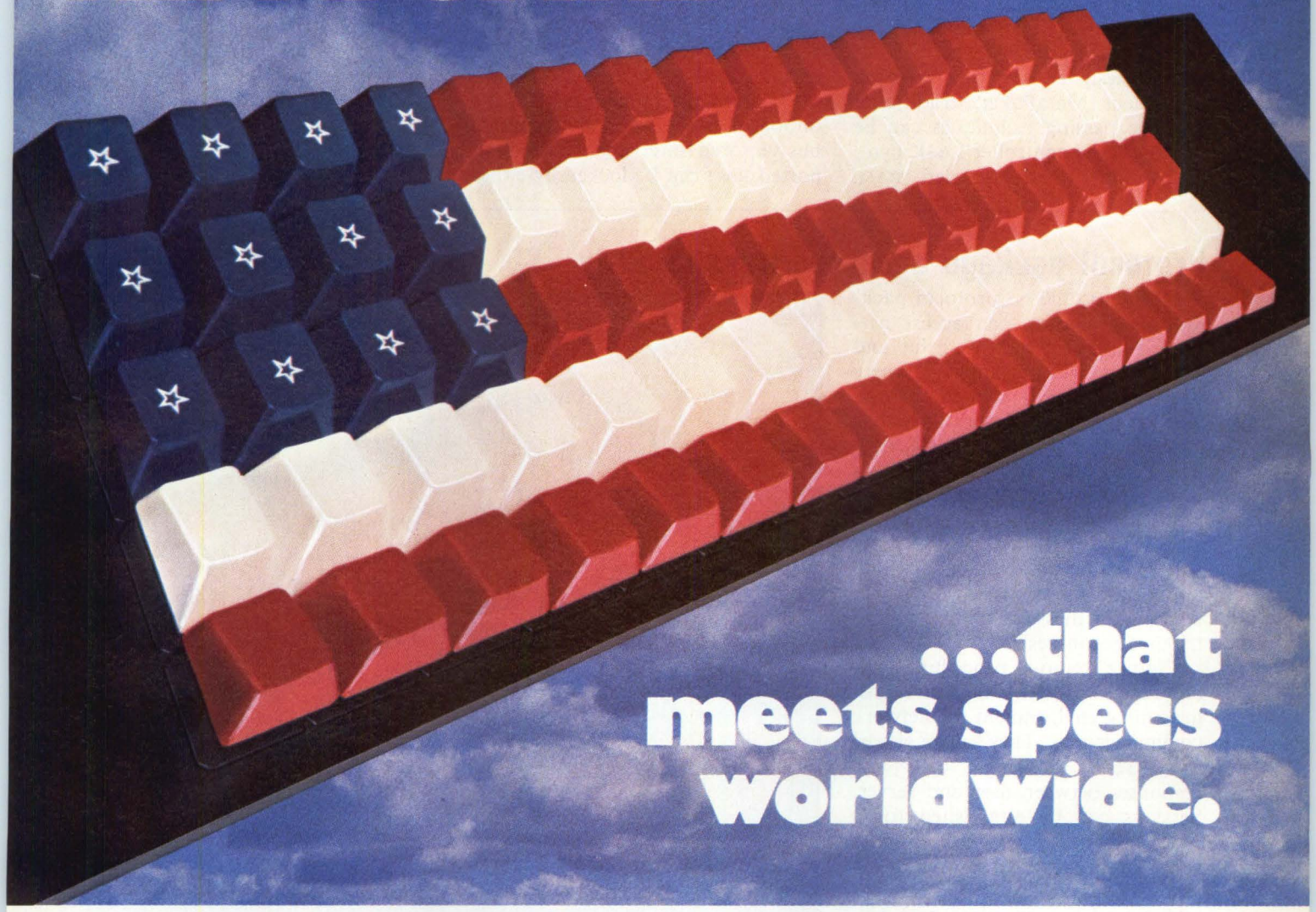
With MetaPaket, high speed parallel data transfers occur simultaneously with other processor tasks. Message transfers use message ports on each company's peripherals, supported by onboard firmware. These ports are accessed as Multibus I/O port addresses and do not rely on Multibus resident memory. Bus access is handled with Multibus master arbitration techniques.

Each message transfer starts with a source requesting a message transfer to an acceptor by sending its ID number to the acceptor's Attention ID register. Up to 16 requests can reside in the register's queue. An interrupt notifies the acceptor of the request.

Simultaneous DMA transfers from the source's local memory to the acceptor's local memory are funneled through their respective data packet ports. Since the company's peripherals support chained buffer operations, messages vary in length and

(continued on page 30)

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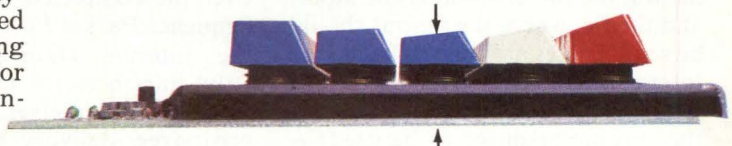
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CIRCLE 21

Plug-in modules

(continued from page 28)

number. Message transfer protocol and password protection are handled in hardware. Optimum transfer rates approach 2M bytes/s.

If a designer does not wish to implement MetaPaket, traditional message passing techniques can be used with the controller's 64K bytes (maximum) of dual-ported RAM. Multiple bus masters are supported with jumper-selectable bus arbitration/surrender modes. Eight vectored interrupts accessed by remote hosts support master/slave CPU handshake signaling. Also, the onboard processor can generate bus-vectored interrupts. The dual-ported RAM can be locked by either the onboard host or a remote host to ensure mutual exclusion during semaphore operations.

Single-unit price for the MPA-2000 controller starts at $2995, with quantity discounts available. **Metacomp, Inc,** 7290 Engineer Rd, Suite F, San Diego, CA 92111.

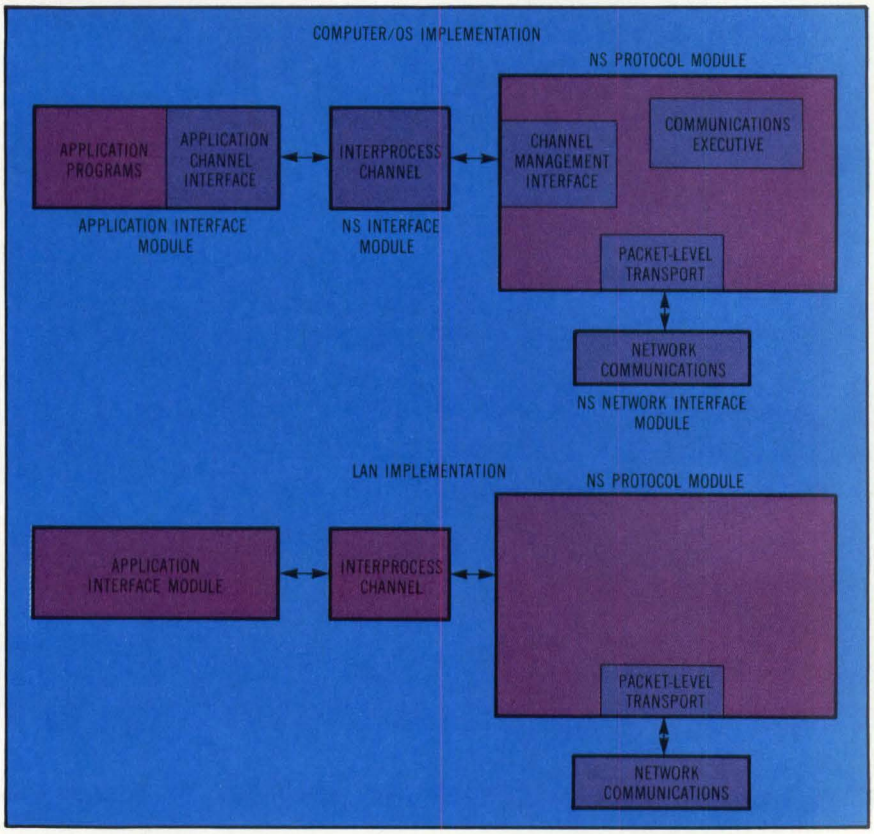
Circle 311

Protocol package accesses transparently

With the ACCESS NS protocol package, programmers can access network resources, such as print and file servers, without knowing where they are physically located. Associated Computer Consultants has implemented the Xerox Network Systems (XNS) protocols through layer 6 (presentation) of the ISO Open Systems Interconnect (OSI) Reference Model. High level Courier calls can be embedded into application programs for error-free transparent message routing to distributed resources.

Courier remote procedure calls and returns provide a high level programming environment for network communications. They can be viewed as a series of single calls and responses between user and server. Sessions can be established for a 2-way dialogue, which eliminates recalling the server every time a message is passed. Neither user nor server need be concerned with network configuration, message routing, flow control, or packet assembly/disassembly.

Further, Courier calls are organized as messages independent of packet boundaries. Messages contain the program's call message, the desired network resource's symbolic names, the file containing the input, and the file where the output should be sent. Tables are used to locate the internetwork address where the request can be sent, and to identify the specific resource to be used. A Courier interface for that given application program builds the message with the calling arguments from the program line and the resource's physical name and address.



The modular architecture and common interfaces of the XNS approach limit the amount of modification needed to adapt to changing computers, operating systems, and LAN configurations.

The Courier interface then turns over the completed message to the Sequence Packet Protocol (SPP) and the Internet Datagram Protocol (IDP) interfaces for transmission to the intended receiver. SPP provides error-free delivery of messages, while IDP promises only "best effort" delivery to destinations that may cross network boundaries. Flow control at the SPP level ensures that network resources are not overwhelmed. SPP roughly corresponds to level 4 (transport) of the ISO/OSI model, while IDP performs functions similar to level 3 (network).

Both SPP and IDP interfaces cooperate to establish a virtual circuit between user and server. Courier call messages are first assembled as a sequence of transport-level packets. Transport-level packets are further assembled as internet datagrams, and finally as physical frames transmitted over links such

(continued on page 32)

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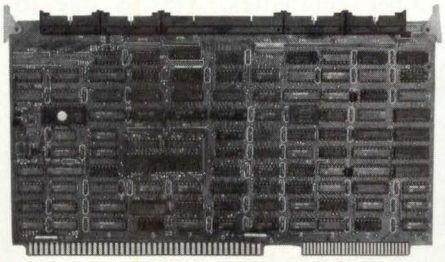
The 440, 450 and 472 feature advanced channel control techniques and are designed to work together for system optimization. For Multibus users, this means low bus usage, non-interleaved disk operation and true high-speed streaming with no repositioning. All three work with any 16, 20 or 24 bit address Multibus system.

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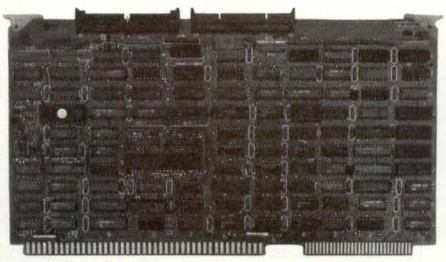
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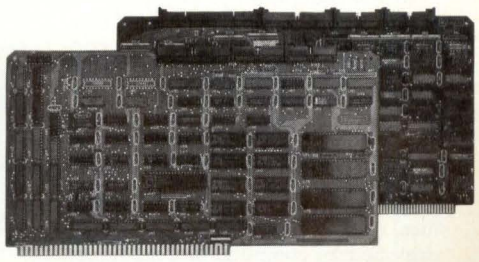
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Xylogics 450 Multibus Disk Peripheral Controller.



Xylogics 472 Multibus Tape Peripheral Controller.



Xylogics 440 Multibus Disk Peripheral Controller.

CIRCLE 22

Protocol package

(continued from page 30)

as Ethernet or X.25. At the remote end, the corresponding interfaces for the data link, IDP, and SPP layers peel off their packets from the envelope of the next lower layer. The remote Courier interface passes the original Courier call message to a program that schedules requests for that resource.

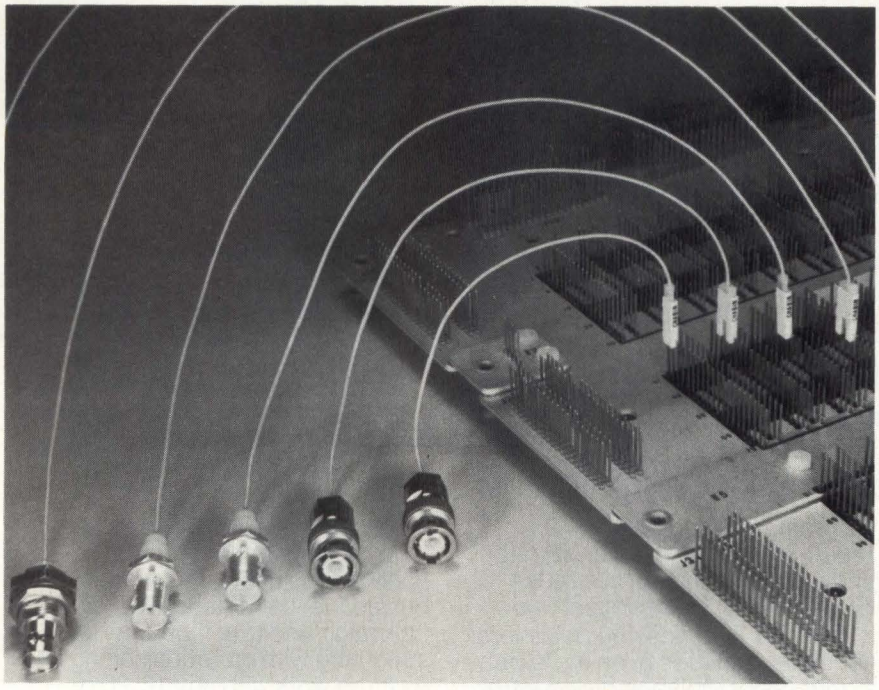
Although a programmer need not directly use the SPP or IDP interfaces, these lower level network functions can be accessed to build gateways between networks or to implement higher level protocols. Programs using SPP first open a socket that acts as a logical channel to a remote resource. Connection is then established for one of three modes: connect, listen, or service listen. Data are transferred after a successful connection, and the user terminates the connection after transmission. Resources must also be de-allocated.

Using IDP directly requires defined higher level functions, since the interface only provides utilities to open a socket, transfer data, and de-allocate resources. Services such as packet assembly/disassembly and error detection implemented in the Courier and SPP layers are missing.

The modular architecture of this implementation complements the layered approach of the XNS protocols. Four program modules isolate dependencies on specific computers, operating systems, and network implementation. The application interface module implements the user interface at the Courier, SPP, and IDP layers. Each submodule can be linked to application programs at load time. The interprocess communication module supports the interaction of multiple application tasks and the XNS protocol module. Appearing as a shared network task, the XNS protocol module contains the actual implementations of the various XNS layers. Finally, the XNS network interface module supports communication between the XNS protocol module and the particular physical network implementation.

Although the initial release is intended for DEC computers, the company claims that the protocol package can be easily transferred to other computers. This is due to extensive coding in the C language at all levels, a realtime executive to manage the network protocol module, and the use of common user and network interfaces to access network services. Changes in computer or network configurations only affect a small part of the code, according to the company.

(continued on page 34)



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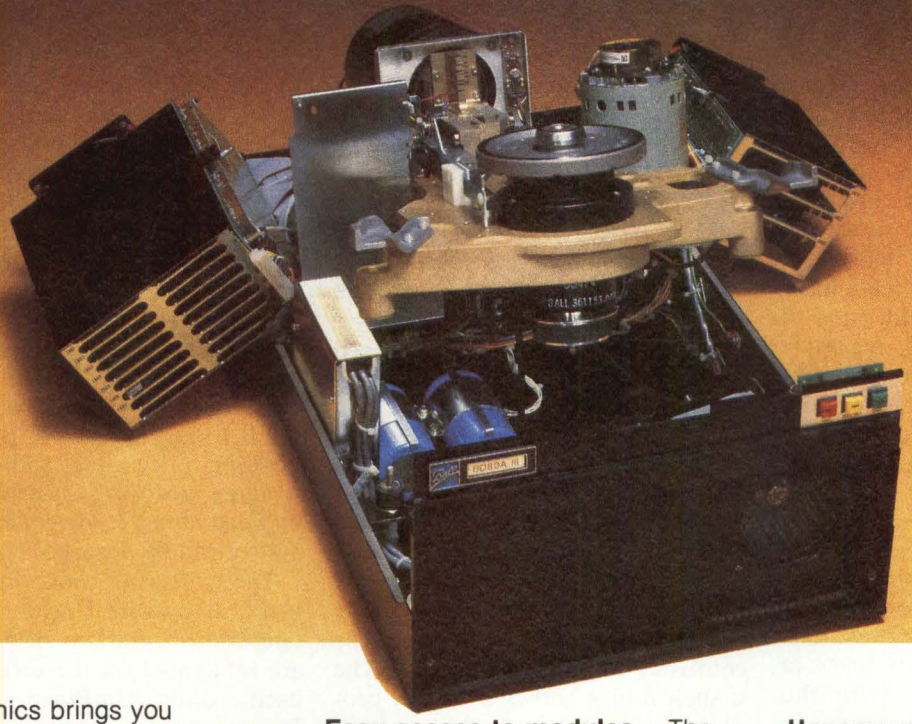
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CIRCLE 23

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Protocol package

(continued from page 32)

An independent realtime executive in the network module limits computer and operating system dependency to the use of the system clock for timer facilities. The executive coordinates multiple application processes, allocates resources (eg, sockets and buffers), handles context switches, maintains a queue of active and waiting processes, and schedules events according to a priority algorithm. Through a single channel to the interprocess communication module, the executive controls access to individual XNS protocol routines from application modules.

Network traffic is funneled through a packet transfer module linked to the network interface module. Rigidly defined interfaces between network levels allow the physical configuration (eg, baseband, broadband, twisted pair) to change without affecting the upper layers of the software. To ease software modification, FORTRAN and C interfaces are provided for the submodules in the application interface.

Two versions of the protocol package are available: the NU-11/NS host-resident model and the FE-11/NS controller-resident model. The NU-11/NS software utility executes on a DEC host running VMS, UNIX, or RXS operating systems. With this software option, all four NS modules reside in the host computer. Communication between the network interface module and the network hardware occurs via the host bus; the module acts as an I/O driver. To choose the appropriate network interface, system designers can configure the system to accommodate a variety of vendors. Single-unit price is quoted at $4500, with delivery 30 days ARO.

The controller-resident model FE-11/NS promises increased system throughput with decreased host processor overhead. Both the NS protocol and the network interface modules reside in firmware on an IF-11/Ethernet controller. The application interface and NS interface modules remain on the host, with the latter serving as an I/O driver. The controller operates as a front-end processor to VAX-11 and PDP-11 systems. Runtime libraries are available for use with either VMS, RSX, or UNIX operating systems. Two hex-wide boards plug directly into the Unibus. Prices start at $9500, with delivery 90 days ARO. **Associated Computer Consultants,** 720 Santa Barbara St, Santa Barbara, CA 93101.

Circle 312

SOFTWARE

Fast UNIX port to 68000 based systems

Uniplus+, derived from UNIX System III with enhancements by U. C. Berkeley, has been ported to Apple Computer's LISA. From UniSoft Systems, UniPlus+ provides a flexible multi-user operating system that supports various utilities and programming languages. The LISA port is the latest of 40 the company has made to 68000 based systems.

Of course, Bell Labs' UNIX is a strong contender as a standard operating system for 16-bit microcomputers. Developed in the C language, it is tailored for the professional programmer and provides many utilities to increase productivity.

UNIX commands are terse (typically less than 7 characters) and can be confusing to nonprogrammers. The C shell utility allows a system programmer or OEM to build a custom interface that prompts the user with questions or menus. It also lets a naive user execute application programs without being aware of the underlying UNIX system.

Uniplus+ includes a C shell, the Source Code Control System (SCCS), the Programmers Work Bench utilities, a C compiler, a 68000 assembler, a screen-oriented editor, and an extensive utility library. In addition, UniSoft has implemented B-Net, a software package that allows UNIX systems to communicate with other systems via Ethernet.

UniSoft maintains UniPlus+ kernel source (C) and object (68000 machine language) code files on an in-house VAX system. It downloads the kernel to a target machine via a serial port. Rather than a workable operating system, the target system only needs a simple monitor that can transfer character data to and from a CRT and a serial port.

UniSoft's ability to download and configure an essentially complete operating system (UNIX) on a minimal hardware implementation allows the system designer to concentrate on hardware. The long, difficult, and expensive process of building, integrating, and debugging a large software system can be avoided, and a relatively inexpensive system can be produced quickly.

The software tools integral to UNIX, along with UniPlus+, facilitate implementation; device drivers are integrated on the target system itself, using UniPlus+ facilities. Drivers for nonstandard devices such as plotters, graphics, and displays are also developed on the target system with these software tools.

A compiled UniPlus+ kernel code occupies approximately 90k bytes, depending on hardware configuration. It requires 256K bytes of RAM minimum, and 5M bytes of mass storage. Also, UniPlus+ can directly address up to 16M bytes of RAM and 8000M bytes of mass storage.

The complete system occupies 5.4M bytes of storage, including 1.4M bytes of online documentation. Maximum number of users supported depends on the number

(continued on page 36)

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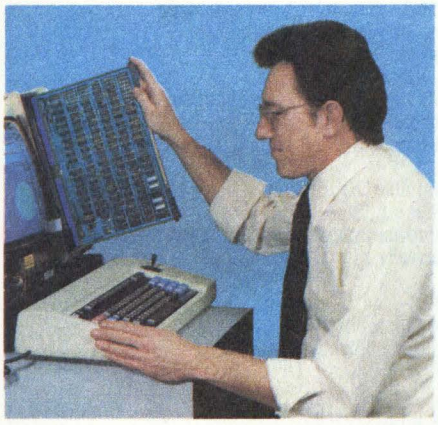
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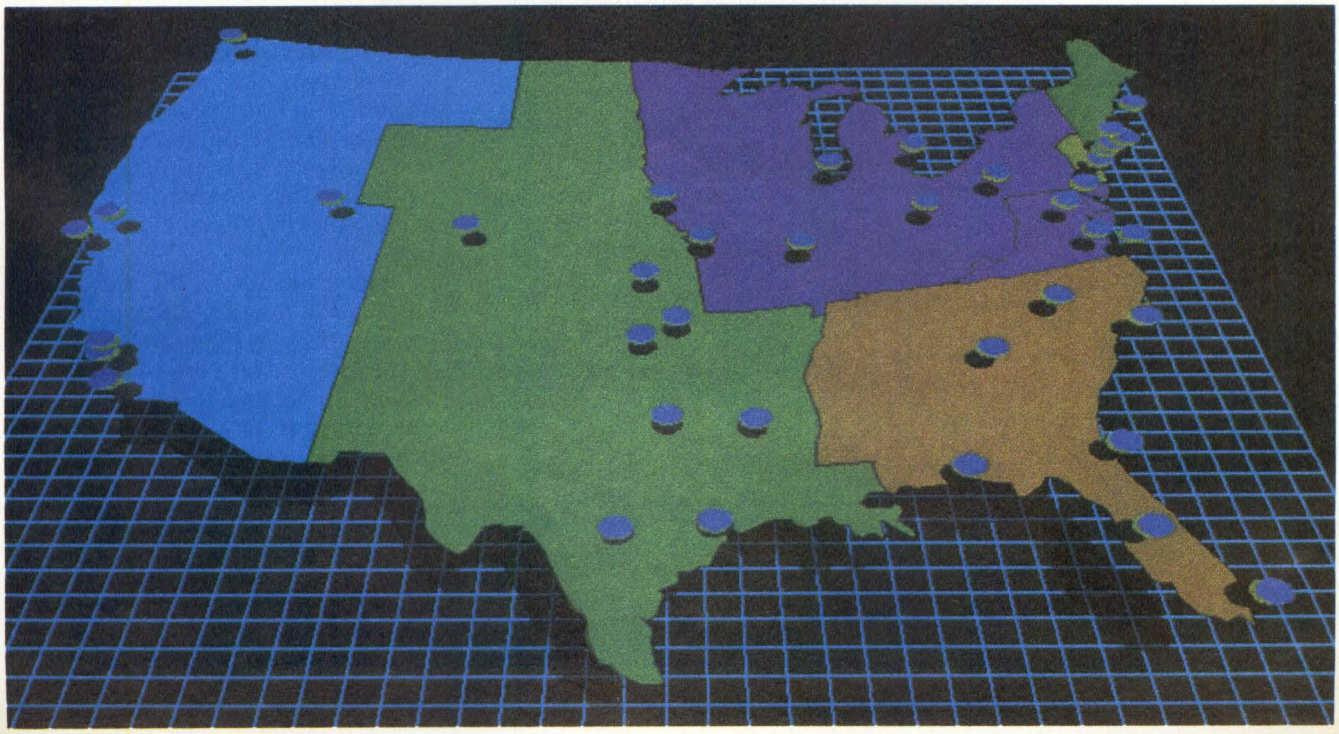
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When you take a close look at our graphics terminals, service, support, software, systems capability, enhancements—and our company—you'll understand why Lundy can help you see more in graphics now and in the long term.

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The Lundy service map was generated on a Lundy T5688 raster terminal. Both Lundy products and Lundy service set industry standards.



CIRCLE 25

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Introducing the IP-512. The first family of OEM image processing modules with high performance features available only on systems costing much, much more.

The IP-512 is a real-time image processor that's plug compatible with the INTEL MULTI-BUS and DEC Q-BUS.

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For details call, (617) 938-8444. Or write to:
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CIRCLE 26

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Fully Multibus Compatible, Terminated Mother Board.

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UNIX port

(continued from page 34)

of hardware device ports supported, the amount of RAM memory installed, and the onboard clock speed. A typical system supports between 4 and 16 users.

A C compiler and 68000 assembler are included with the basic UniPlus+ system. An ISO Standard Pascal compiler with UCSD-compatible extensions, BASIC-Plus, and FORTRAN-77 are optional languages. A Ryan-McFarland COBOL compiler for the 68000, and a macro assembler with a linker/loader and a utility to convert source code from assembler to Motorola standard syntax are used for programming applications.

In addition, two applications-oriented software packages are available: UniSoft's ViewComp, a UNIX spreadsheet program; and Virtual Microsystem's The Bridge, a CP/M simulator in 68000 code, with performance equivalent to an 8080 at 1-MHz clock speed.

UniPlus+ installation cost depends on complexity. A simple implementation on a known hardware configuration is $15,000, and takes two to three days. Implementation with memory management unit (MMU) hardware begins at $20,000, with each new device driver priced at $5000. Integration of an existing device driver costs $2500.

One year of maintenance is included in the basic fee. Source licenses and reconfiguration rights are available, as is an OEM discount schedule for royalties on binary copies of UniPlus+ distributed to end users.

Twelve weeks is the maximum installation time for UNIX on a new 68000 system with unfamiliar hardware; two to three days for systems essentially similar to one on which the company has already installed UniPlus+. **UniSoft Systems**, 2405 Fourth St, Berkeley, CA 94710.
Circle 313

Talk to the editor
Have you written to the editor lately? We're waiting to hear from you.

CIRCLE 27

LANC™

DEFINITION: LOCAL AREA NETWORK CONTROLLER.
SMC'S COM 9026–THE FIRST COMMERCIALLY AVAILABLE SINGLE-CHIP LOCAL AREA NETWORK CONTROLLER.

NOW AVAILABLE: BOARD LEVEL PRODUCTS UTILIZING THE COM 9026.

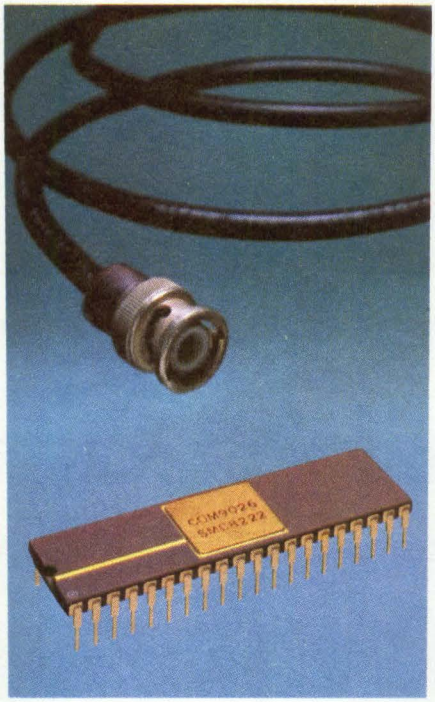
What company would you expect to lead the way with something no one else in the semiconductor industry offers: a VLSI circuit controller for a local network that replaces over 100 SSI/MSI circuits with just one chip?

Standard Microsystems, of course.

Our COM 9026 Local Area Network Controller is the first commercially available MOS/VLSI circuit for local networks.

It's a complete protocol handler for token-passing systems such as the ARCNET system used by Datapoint, Tandy and others.

The COM 9026 supports a self-polling token passing network operating at 2.5M Baud data rate. It avoids the fluctuating channel access times caused by data collisions in CSMA (Carrier-Sense Multiple-Access) schemes. The COM 9026 also contains a micro-programmed sequencer and all the logic needed to follow the token passing on the network and send or receive data packets at the appropriate time.



Other functions include address decode, CRC checking and generation and packet acknowledgement and support of up to four 508 byte buffers.

The COM 9026 is a high-density n-channel silicon gate MOS circuit fabricated with SMC's COPLAMOS® technology. It's packaged in a 40 lead ceramic dual-in-line package and is immediately available in production quantities on an off-the-shelf basis.

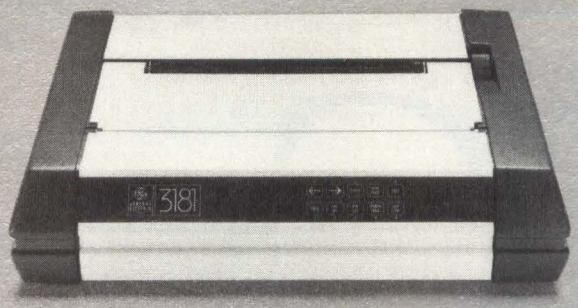
For information on the COM 9026, contact Standard Microsystems Corporation, 35 Marcus Boulevard, Hauppauge, NY 11788. (516) 273-3100.

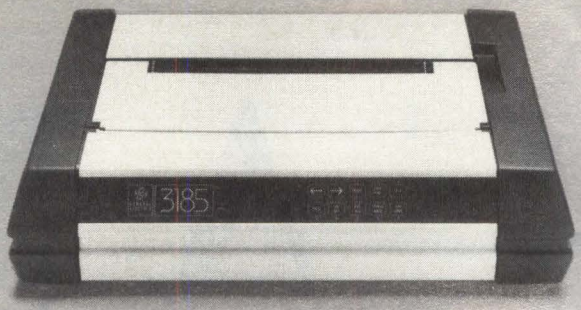
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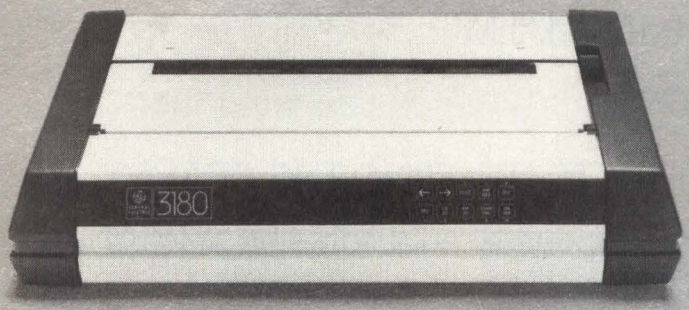
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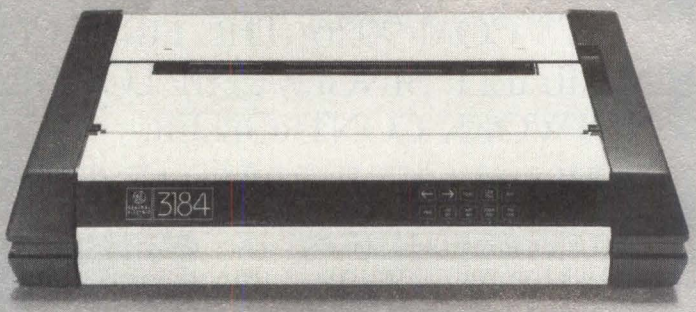
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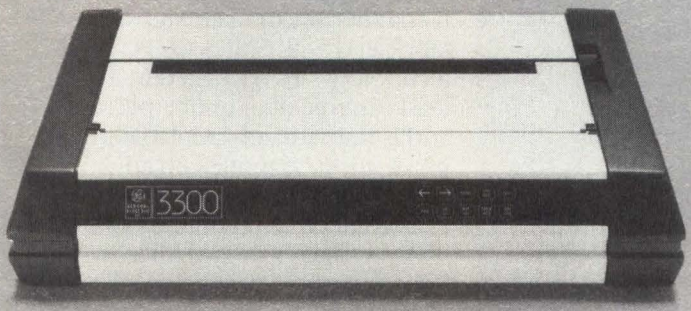
CIRCLE 28

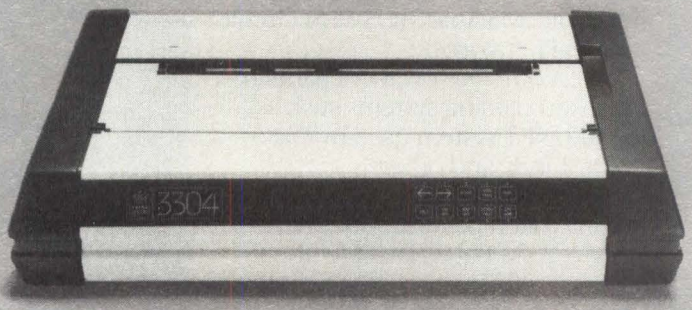

3181

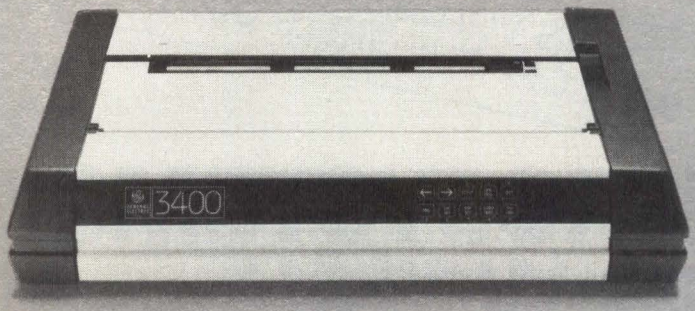

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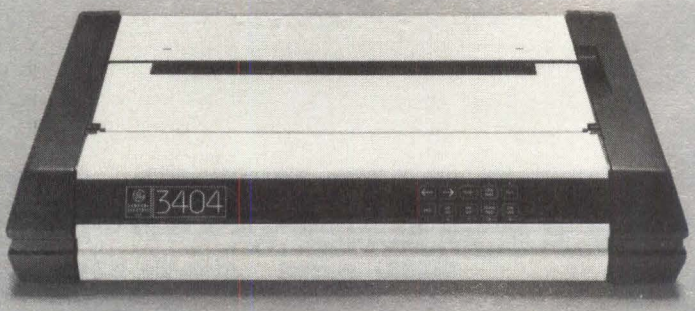

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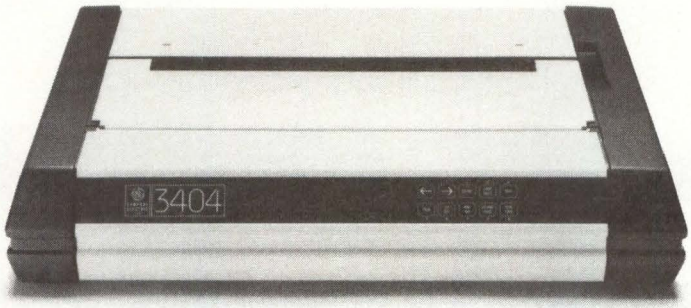

3304


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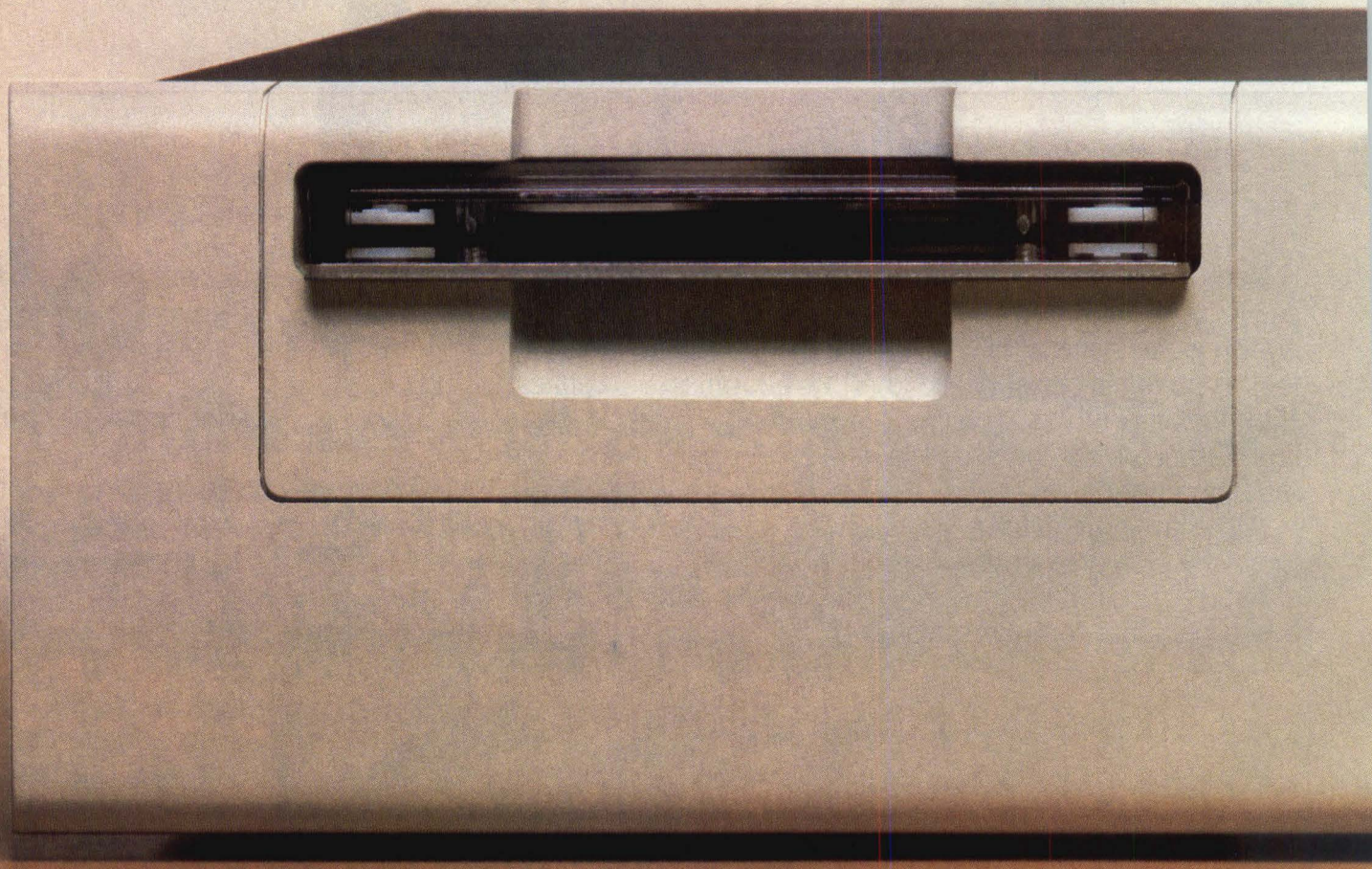
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GENERAL ELECTRIC

CIRCLE 29

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See us at NCC, Booth #P-7424

Introducing the DSD 890
DEC-Compatible Winchester/Tape.

Last year, Digital users made a big deal about our 880 Winchester/Floppy system, with its incomparable features, performance and price. And ever since then, they've been crying for more of the same, only with a tape back-up instead of a floppy.

So be it.

Witness the 890 Winchester/Tape. A 31.2 Mb Winchester and an ANSI standard ¼" cartridge tape drive for quick and inexpensive archival storage, back-up and software distribution. All in one neat package.

To get the same kind of capacity from Digital, you'd need a whole rack full of equipment.

Three RL02s and a TS-11, to be exact.

And you still wouldn't get the same kind of performance. The 890 is up to 15% faster than the RL02, thanks to our non-interleaved data transfer mode. (We can even handle simultaneous instructions to the Winchester and tape with no, we repeat, no degradation in performance.)

There's a big difference in price, too.

The 890 is about half the Digital alternative.

Yet it's just as compatible.

Our Winchester emulates the three RL02s you don't have to buy. And our tape emulates the TS-11 so that you can use all of DEC®'s handy back-up utilities. What's more, our emulation of the RL02 and TS-11 allows you to take full advantage of 22-bit addressing.

We've even designed our front bezel so it goes nicely with a PDP®-11/23.

And we've improved our HyperDiagnostics.™

Not an easy task to be sure, but on the 890, one button runs all self-diagnostics and testing. You don't even have to take off the bezel; there's a convenient little open/close front door instead.

Some things remain unchanged, though.

Like our Rapid Module Exchange,™ HyperService,™ and our nationwide sales and support network.

Because, quite frankly, we think they're already pretty good.

But if there's anything you think we can do to improve them, please let us know.

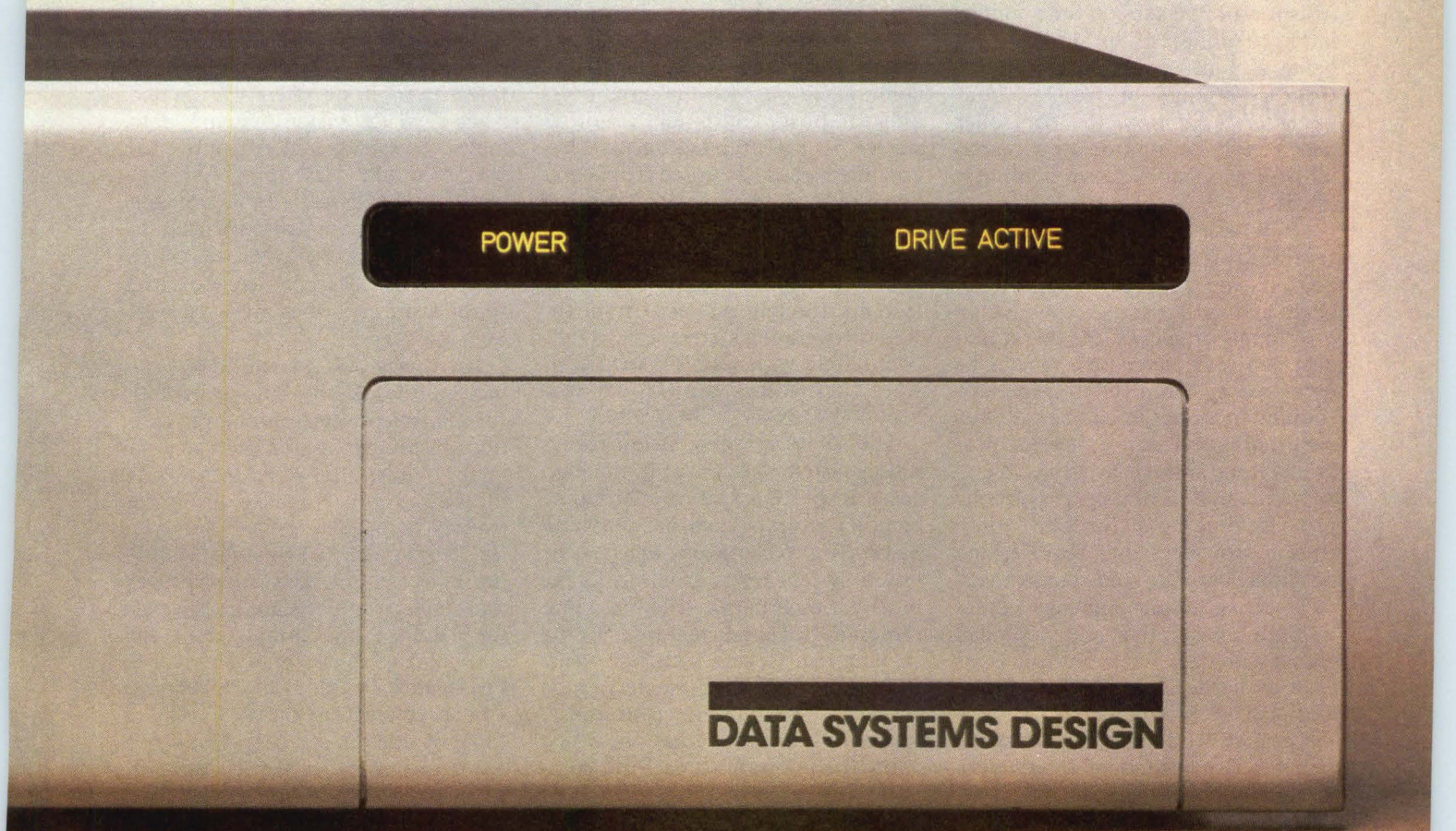
We don't want to say we're responsive, but when you say "jump," we leave the ground and wait for further notice.

Which explains why we're so high on the 890.

Corporate Headquarters: 2241 Lundy Avenue, San Jose, CA 95131. Eastern Region Sales and Service: Norwood, MA, (617) 769-7620. Central Region Sales and Service: Dallas, TX, (214) 980-4884. Western Region Sales: Santa Clara, CA, (408) 727-3163.

DATA SYSTEMS DESIGN

CIRCLE 30



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Advanced features ease robotics integration

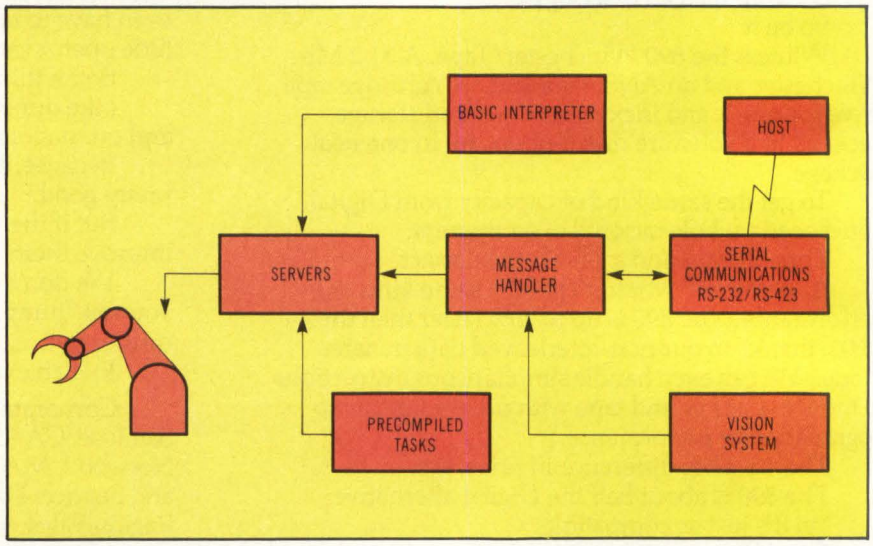
Compatible hardware and software application and development tools, claimed to provide "third-generation" robotics technology to industry users, OEMs, and system integrators, are being introduced by Machine Intelligence Inc and its Japanese partner, Yaskawa Electric Co. Included are robot manipulator arms and their controllers, a robot programming language that is a superset of BASIC, two machine vision systems, and a software system for developing vision system applications.

An intelligent robot system, the Model 3030 consists of a low level controller for the manipulator arm. This arm is driven by a high level controller based on a DEC LSI-11/23 computer that runs DEC's RSX-11S operating system. Sequence and motion control are handled by a Z80 processor that updates servo controls for all five axes on the manipulator 60 times/s. In addition to being user programmable in BASIC from a terminal or from a front panel or teach box, the controller has serial communication capabilities to enable host computer interaction.

Model 3030 can be programmed in several different ways. The teach box allows it to be taught exact poses and motions; up to 99 distinct positional sequences can be stored at a time. These sequences can be used as a complete routine for running the robot or can be called as subprograms from a BASIC program. Programmers are thus able to combine BASIC's high level symbolic programming and flexibility with certain sequences that require high positional accuracy and compactness.

Extended BASIC language comes in both interpretive and compiled forms with calls for robot functions such as ROPEN to open the gripper and RMOVE (coordinates) to move the arm. Coordinates can be specified for five frames of reference—world, tool, joint, vision, or a user defined coordinate system.

Software communicates with the robot controller via a set of servers that receive their input from several software sources. One source is the BASIC interpreter, in which data are received from a message handler communicating with the serial ports and a host computer; another source is precompiled tasks. Precompiled tasks can come from compiled BASIC programs, from software developed on the DS-100 development system, or from teach-box routines. This robot operating system, though distinct from the RXS-11S operating system, is also fully compatible with vision system software and allows both robot and vision systems to fit as a whole.



Robot servers, which control the Model 3030's manipulator, take their input from the BASIC interpreter, from precompiled tasks, or via a message handler. The message handler transmits commands from a host computer and also allows the vision system access to robot control.

The VS-100 machine vision recognition system specializes in the high speed inspection and recognition of complex objects such as tools and parts. To recognize objects, the vision system maps from an image into various data structures that represent regional features in the viewing field. These features consist of many possible parameters, such as area, perimeter, roundness, aspect ratio, and orientation, which allow the program to perform computations based on them.

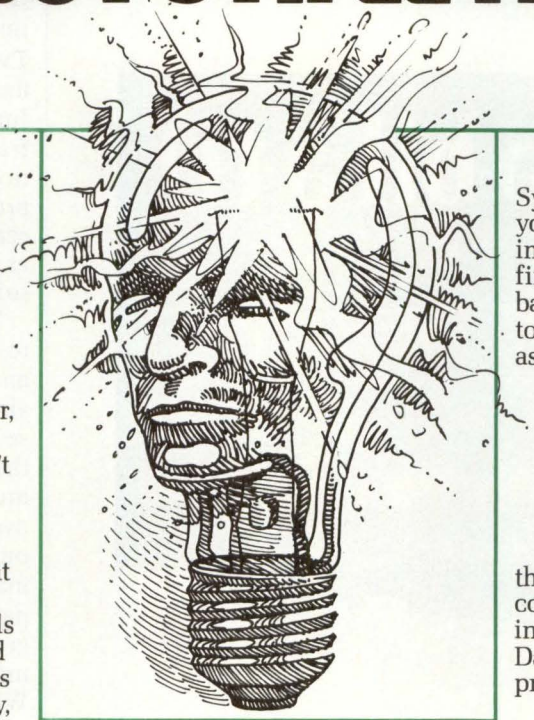
Parameters that apply to the object in question are selected from the list in order to define the object. The vision system can then look at a region in the viewing field and recognize a shape in a different orientation (eg, by performing a transform on it) in an attempt to match what is in the vision system's data tables. The vision system can be programmed like the robot controller with BASIC calls such as VSENSE and VPICK. These calls are dispatched to the vision processor, via the same message handler that controls the robot arm, as if they were external host messages.

Another vision system, the VS-110, incorporates a masking capability for realtime inspection and recognition of complex parts. By using an image overlay, the VS-110 transforms the sensed image against an image overlay before the system "sees" it. By ADDing or XORing bits against this image plane, the system ensures that only certain bits are let through (eg, those that might represent anomalies), thus greatly reducing the needed amount of processing and speeding throughput.

To enable the engineer who is not a programming expert to develop software for the vision system, the DS-100 development system provides a hierarchical structure of menu displays. The menus allow the user to select options for image recognition

(continued on page 44)

AT DATRICON WE BELIEVE THE STD-BUS SHOULD FOSTER INNOVATION NOT STIFLE IT.

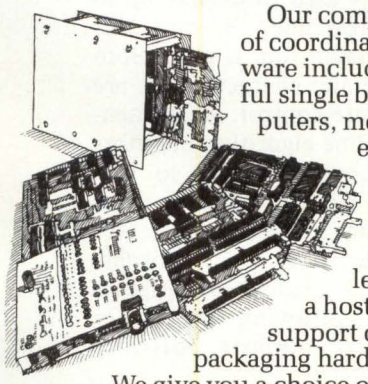


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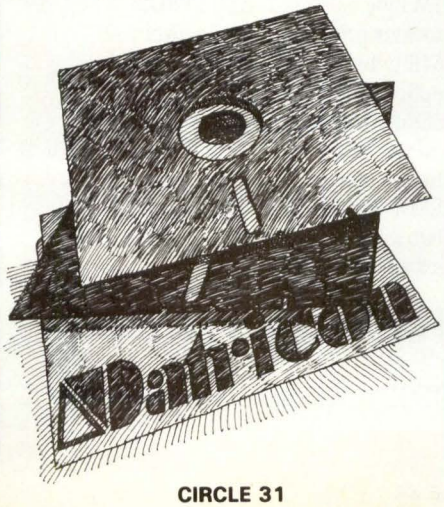


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D-FORTH is our own enhanced FORTH-style language system. The inherently ROMable code produced by D-FORTH eliminates the development/target system dichotomy and associated problems common in other language implementations.

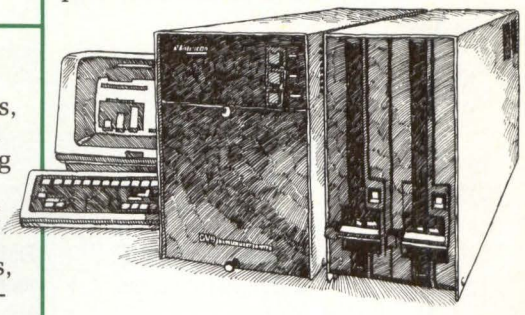
For general purpose applications, we offer OS-9*, the most advanced multi-tasking, multi-user operating system available for 8-bit microcomputers. OS-9 provides support for BASIC-09, PASCAL, COBOL, C, and a wide selection of business, word processing and special applications programs.



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* OS-9, trademark of Microware

CIRCLE 31

Features ease integration

(continued from page 42)

and task building, as well as procedures for creating BASIC programs. Programs combining vision recognition functions and robot motion operations can be developed on the DS-100 for applications including in-process inspection, parts identification and sorting, fastening operations, and robot guidance. Completed programs can then be loaded in the 3030 system or transmitted to a host for interaction with the complete robotics system. **Machine Intelligence Corp**, 330 Potrero Ave, Sunnyvale, CA 94086.

Circle 314



COMPUTERS

Multiple windows ease programming

Using multiple windows on Solo-Systems' single-user/multitasking workstation, programmers can switch from editing to compiling IBM OS/VS COBOL program modules. Two MC68000 microprocessors handle CPU and display control functions to bypass the host mainframe computer until final compilation and execution. Thus, host processor resources are free to concentrate on production tasks, such as data management, instead of software development.

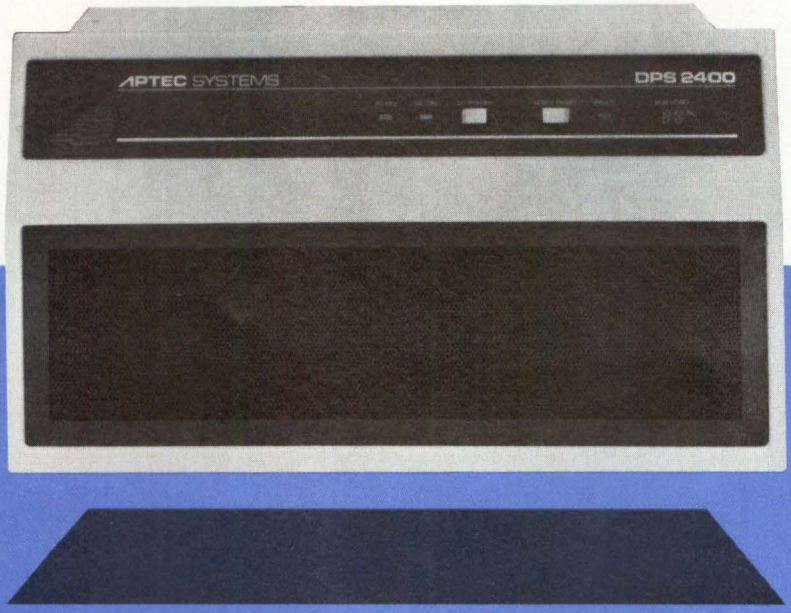
Windowing allows programmers to easily switch from one task to another; each window serves as a virtual terminal dedicated to one of several software tools. As viewed on the 1024 x 704 bit-mapped display, multiple windows are stacked with overlapping edges like papers stacked on a desk. The user can see all information on the top page, but only part of the background pages. Background pages are fully viewed by moving them to the top of the stack. While a Pascal based operating system oversees tasks operating within each window, it is not involved with window display control.

Window sizes vary in character and line size up to 70 lines of 140 characters each. One of two character fonts is used to display up to 100 characters/line. Beyond this limit, the smaller font is used. Both window size and character font are under software control. An elementary hidden-line algorithm monitors background page display so that overlapped sections do not show through. One MC68000 processor handles the 1024 x 704 display memory and associated graphics processing, allowing the other processor to support software development.

The company claims that mainframe computers are not optimized as programming tools, even though approximately half of their resources are devoted to software

(continued from page 48)

THE SIMPLE SOLUTION TO COMPLEX SCIENTIFIC COMPUTING.



Now You Can Create a 10 to 100 Megaflop "Supercomputer" for Your VAX* Using Multiple Array Processors.

Introducing the DPS-2400 Dimensional Processing System™ from Aptec. It's an evolutionary system concept that lets you configure powerful attached subsystems — using your choice of multiple array processors and other peripherals — free from the bottlenecks of current approaches.

Data acquisition and multiprocessing systems deliver far greater power when controlled by DPS-2400 than when controlled directly by your host.

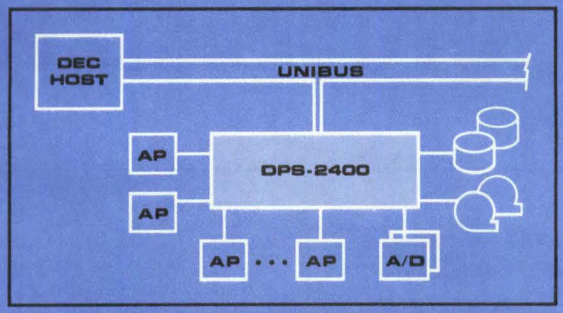
The solution is simple when you start with DPS.

DPS-2400 attaches to the UNIBUS* of your VAX* or PDP-11* computer to form the central node of an attached subsystem using UNIBUS-compatible peripherals. DPS contains a 24MB/sec. Data Interchange Bus to handle multiple, concurrent data transfers without loading your UNIBUS. Up to 24MB of high speed mass memory provide efficient data staging for pipelined and parallel processing used in 2-D and 3-D applications. And, a set of fully programmable Data Interchange Adapters provide individual control of all DPS subsystem peripherals, including up to ten array processors.

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Aptec support speeds and simplifies application development.

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The Dimensional Processing System from Aptec. There's no simpler, faster, or more economical route to a working solution for scientific computing.

For more information or to arrange a demonstration contact Aptec today.

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CIRCLE 33



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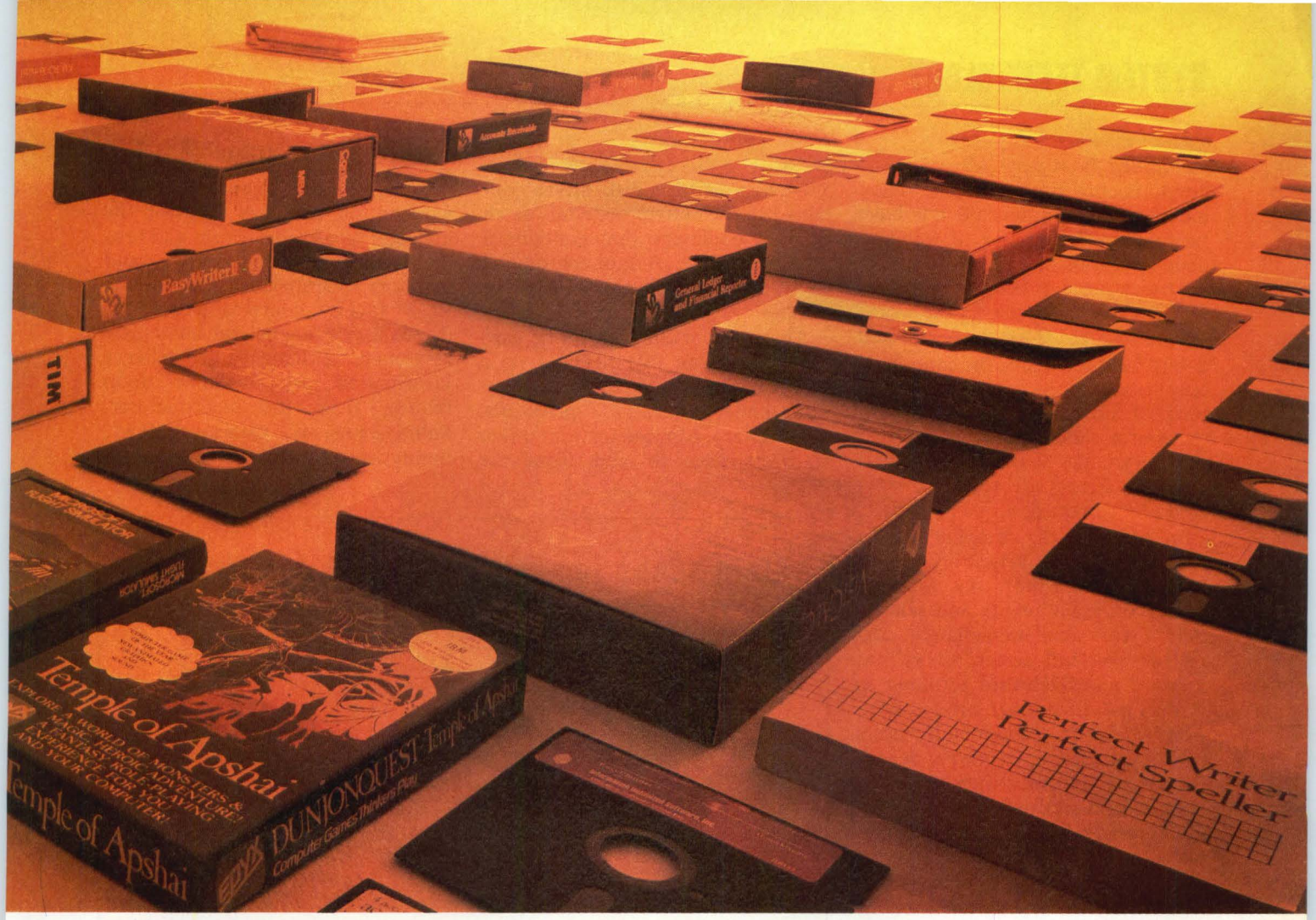
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Multiple windows

(continued from page 44)

development. For example, many mainframe computers do not have facilities or techniques to test and debug programs.

Dedicating a processor with IBM 370/145 capabilities allows the workstation to provide extensive test and debug facilities. Using the compiler's output, a verifier utility simulates program execution. Users can view the source code, output, and values of the variables as the object code is executed. Errors are quickly discovered and corrected.

In addition, the compiler can be used just as effectively. Linked with an interactive editor, the compiler checks program syntax and semantics. Errors are immediately corrected. The full screen editor has forward and backward scrolling as well as a 4-directional cursor. With word processing commands, users can insert, delete, overtype, search for strings, and substitute.

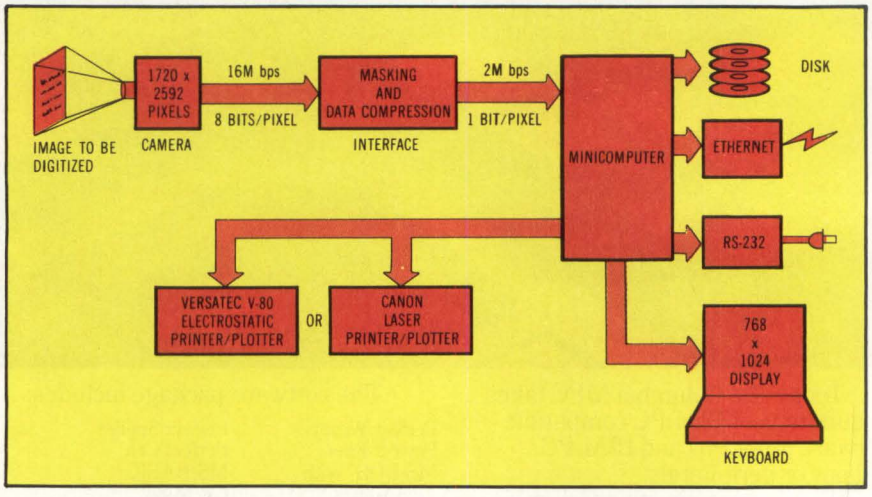
Less sophisticated viewing facilities are also provided. The comparator allows a user to compare any two files line by line to identify differences between program versions and revisions. With the viewer, users can scan programs as they can with the editor, but they cannot make revisions.

Also included are software tools seldom found on any other computer, according to the company. A profiler facility tracks how many times a phrase or routine is accessed during program execution. A user can optimize program performance by identifying where it spends the most execution time. A cross-reference utility pinpoints where variables or names are referenced in source code. In addition, a diagrammer automatically generates program flowcharts. This utility takes the compiler's output and displays control flow on the left side. Indents denote nested structures.

Physically, the workstation houses the dual 68000 microprocessors with 512K bytes of main memory and 256K bytes for display. Main memory is dedicated to the system processor, but both processors share part of the display memory. Full semaphore handling is provided for task synchronization. Local mass storage consists of either two 5M-byte cartridge disk drives contained in the system pedestal, or an external enclosure that contains a 25M-byte drive. A monochromatic 15″ (38-cm) CRT screen is used for display.

The 1116 workstation can be used alone, or as an IBM terminal via a 3705 communication controller operating under BSC or SDLC protocols. A software communication utility transfers data to and from the mainframe host computer. The workstation also has its own file manager to provide system and program backup, data security, and directory maintenance. An online HELP facility contains a context-driven user's manual for immediate reference. Pricing and delivery information are available upon request from the manufacturer. **SoloSystems**, 482 Oakmead Pkwy, Sunnyvale, CA 94086. **Circle 315**

System scans images for digital data bases



Functional block diagram of Data-Stat's AUDRE system, showing a typical configuration. The controlling subsystem, a Three Rivers minicomputer, acts as an interface between the CCD array (camera) and all output devices.

Image information is digitized and stored in a picture data base with Data-Stat's integrated system for automatic digitizing and recognition (AUDRE). Key to the AUDRE is a linear CCD array camera and a dedicated DMA interface to a high speed TTL bit-slice processor. This system is designed for applications that require high resolution imaging and data manipulation, such as automated parts inspection, digital feature extraction, or radiographic image comparison.

Manufactured by Datacopy Corp (Palo Alto, Calif), the system's camera uses a 1728-element linear CCD array that moves across the image plane to generate a digitized image. A 35-mm camera lens, mounted on the front of the camera housing, creates the image. The image plane is approximately 25.9 x 38 mm, roughly equivalent to 35-mm film.

Out of 1728 elements, 1720 are used to generate the image. While the array is physically moved across the image plane, each element is scanned every 880 μs. The scan produces 4,458,240 pixels (8 data bits/pixel) and a resolution of 33 line pairs/mm. Minimum frame rate is 2.35 s/scan, and the video rate is 2 MHz.

Also from Datacopy, the interface circuitry accepts data from the camera at 16M bps (8 bits/pixel at the video rate), and converts it to a 1 bit/pixel representation by bit-masking, thresholding, and linear-pixel interpolation in hardware. Parameters for the input bit mask,

(continued on page 59)


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LATEST IN
FAMILY
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OUR LITTLE ONE.

There's a great future ahead of this one.

And for a number of reasons.

Not the least of which is the fact the new SA300 Microfloppy uses the standard 3½" cartridge media.

And as part of a new generation of products, our SA300 will open up a whole new generation of applications for you.

Smaller, more compact portable and personal computers, desktop systems, electronic typewriters, and all kinds of computerized office equipment.

It's no toy, either. At 80 tracks per surface and 300 RPM, the SA300 uses proven technology to yield half a megabyte of storage in this single-sided version.

What's more, it's also I/O compatible with the bigger Minifloppies. And has the same transfer rate. So it can be integrated into your new system without a big software or controller investment.

And like most youngsters, the SA300 is very quick. Just 6 milliseconds, track-to-track.

But surprisingly well-behaved. Thanks to microprocessor-controlled electronics and internal write-protect circuitry.

Still, it uses less power than an 8-watt nightlight.

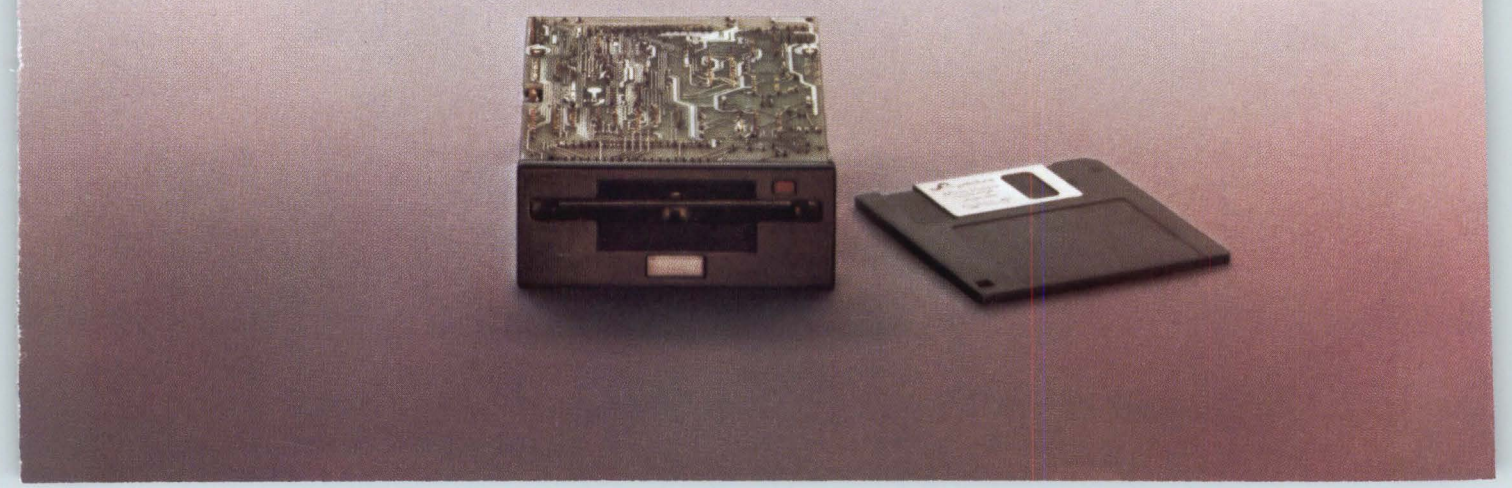
Because it's so small though, we expect our new Microfloppy to get bounced around a bit.

So we've made it extra rugged. With things like a dependable, brushless direct drive DC spindle motor. And a die cast aluminum base casting.

Even the media is tough. In order to withstand the rigors of shirt pockets, crowded briefcases and even inquisitive little fingers, it's protected by a hard shell, and an automatic cartridge shutter.

The SA300 is the handiwork of one of our "Venture Groups," a special engineering and marketing team chartered with developing new products and getting them out the door, quickly.

As for the SA300, their latest accomplishment, the kid, as they say, definitely has possibilities.



IT'S A NEW FROM

OUR BETTER HALVES.

This could be love at first sight.

And perfectly understandable, considering how much our new half-height drives have going for them.

Take our half-height SA810/860 8" floppy drives, for instance.

Their 12" CRT depth means they can sit next to a screen. Or, you can put two of them anywhere a full-sized 8" floppy used to be. For an instant system upgrade, up to 3.2 megabytes.

Looking for something more compact?

Our half-height, double-sided SA455/465 Minifloppy™ drives were made for you. The 48tpi SA455 delivers 500 Kbytes, while the 96tpi SA465, a healthy 1 megabyte of unformatted capacity.

And they're quick. Just 3 msec track-to-track for the SA465, and 6 msec for the SA455.

They'll stand by you, too. Like our 8" half-heights, these new Minifloppy drives are moved by brushless direct drive DC motors, and deliver an endearing 10,000 hours MTBF—25% more than most full-height drives.

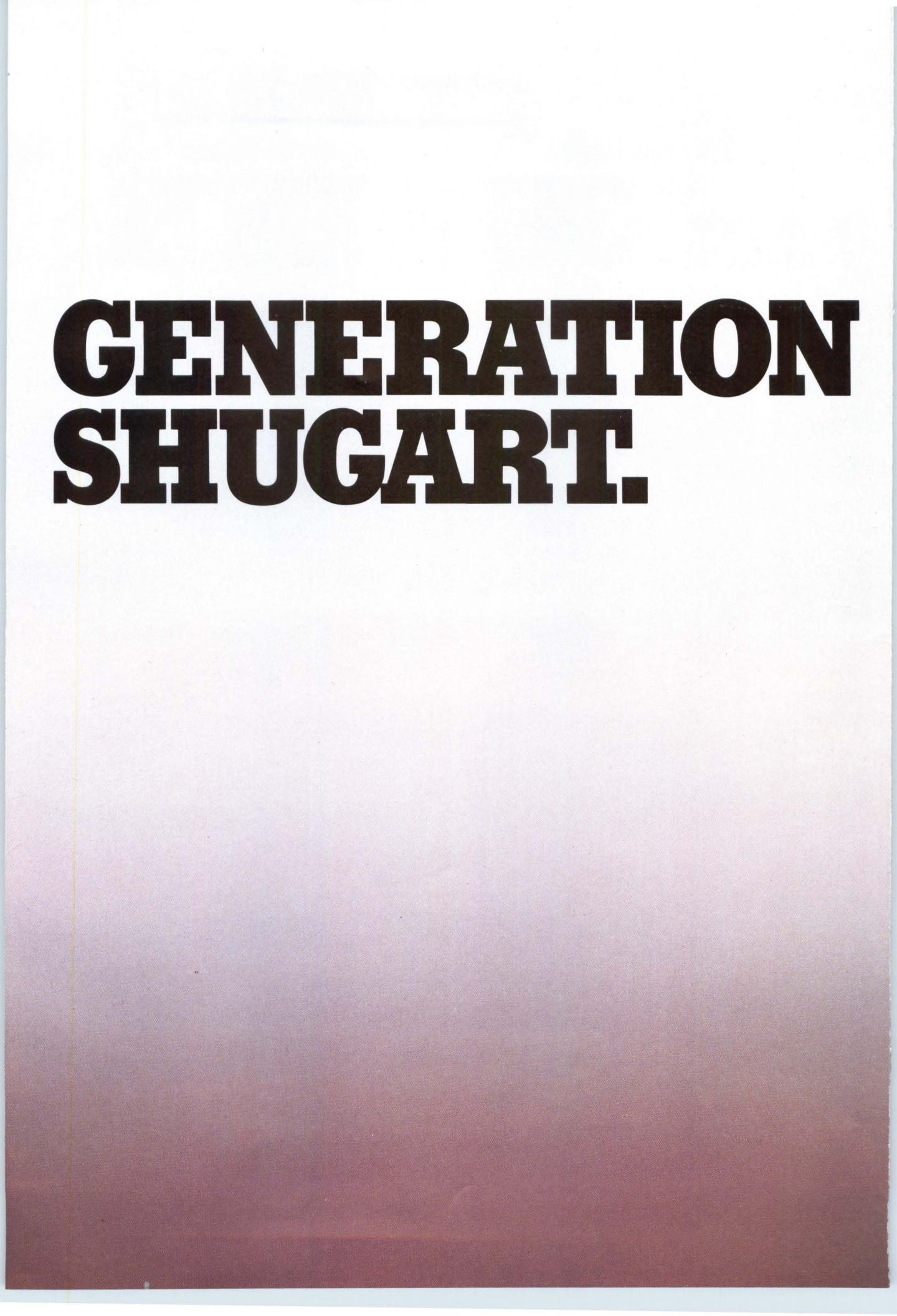
Finally, meet our new 5¼" half-height Winchesters, the SA706/712. With 6.6 or 13.3 megabytes unformatted capacity and more data protection features than any other small Winchester on the market. Features like 4-point shock and vibration mountings, head landing zones, automatic spindle and actuator locks, and a new low-mass head. All of which make it a perfect match for your rugged portable system. Or team it up with our half-height Minifloppies and get a combination that'll have your competition talking. To themselves.

Of course, all these drives are available in full-height versions. All from the company that gave birth to the OEM disk drive industry ten years ago.

Which just goes to show you how important it is to marry into the right family.



GENERATION SHUGART.



THE GLEAM IN OUR EYE.

Oh, do we have plans for you.

Last year, we spent $20 million on R & D.

And the same on capital equipment.

This year we'll do likewise, and more.

We're not trying to impress you.

They're just the facts of life.

Because the fact is, there is no one who can commit the kind of resources to furthering the state-of-the-art in this business that we can.

What kinds of advancements are we looking at?

State-of-the-art media, thin film heads, vertical recording, and particularly exciting developments in optical recording technology. (Just imagine what you could do with 10 times the storage capacity currently available . . .)

And when we've improved and refined our designs some more, we'll tell the world. In fact, you will be seeing some tech articles sometime this year.

A lot of our work is paying off right now.

In higher quality levels, thanks to our implementation of progressive assembly, robotics, automated manufacturing and Class 100 clean tunnels.

In faster, more reliable disk drives and controllers in all sizes, achieved through custom LSI technology and improved vendor quality levels, and the benefits of the ten years of experience in this industry.

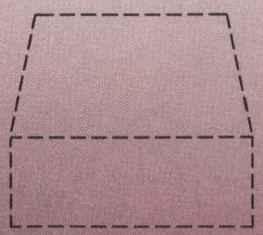
And in better service and support, by constantly improving the largest service and support network in the business.

Our new generation is more than just new products.

It's a new presence that will drive an entire industry to provide you with the kinds of options that will allow you to do some pretty exciting new things yourself.

Because we can see you've got that same gleam.

So maybe it's time we got together.



THE PROUD PARENTS.

Success seems to be hereditary.

More than 10 years ago, Shugart produced the first OEM floppy disk drive, and gave birth to an industry.

A little later, we presented the industry with the first Minifloppy.

Today, we have more than 3,000,000 floppies in the field.

And more than 100,000 rigid disk drives.

In between, we've managed to produce the largest family of disk drives in the world.

From 14-inch Winchesters to our new 3½" Microfloppy.

And we're not about to stop here.

We'll continue to provide you with the greatest number of options in disk storage.

And commit our considerable resources to improving those products so they can improve yours.

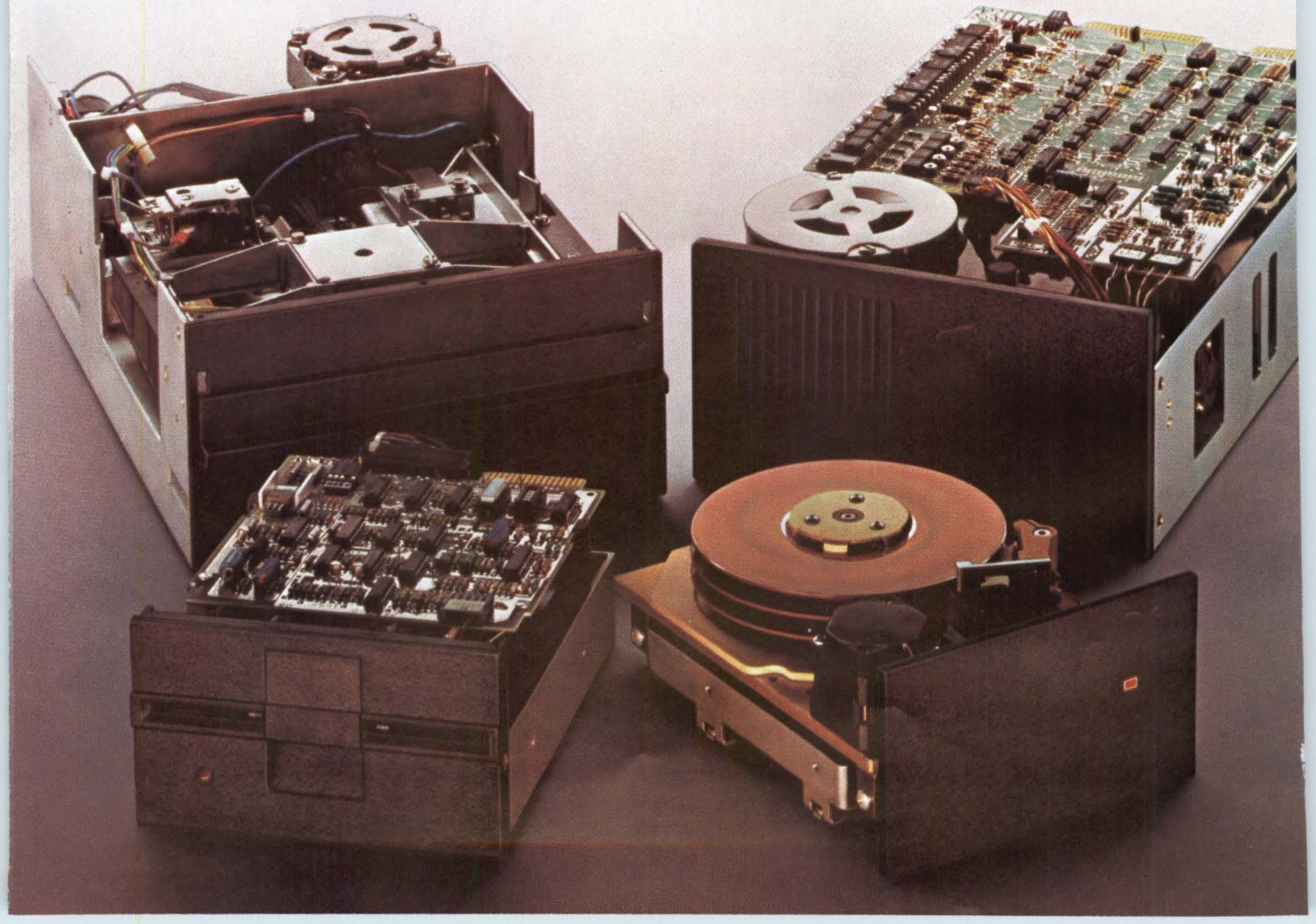
We'll be there when you need us, too.

With worldwide sales, service, and support. We do, after all, have to take care of our own.

And who knows? Maybe we can help you build a family of your own.

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THE NEW ARRIVALS.

Cute, aren't they?

And smart, too.

But then, what do you expect from a custom LSI chip set?

Our new SA1600 "SASI" Controllers have the intelligence to provide true device independence. The on-board microcomputer and four custom chips take on many of the tasks previously performed by the host CPU. Such as distributed arbitration, over-lapped seeks, buffering, and more. So overall system performance is improved since the CPU is free to go on to bigger and better things.

These little babies are reliable, too. Again, thanks to our custom chip set, we were able to reduce the number of components.

Which also means that our SA1600 Series won't put you in the poorhouse. Especially with a price that's less than half that of previous models.

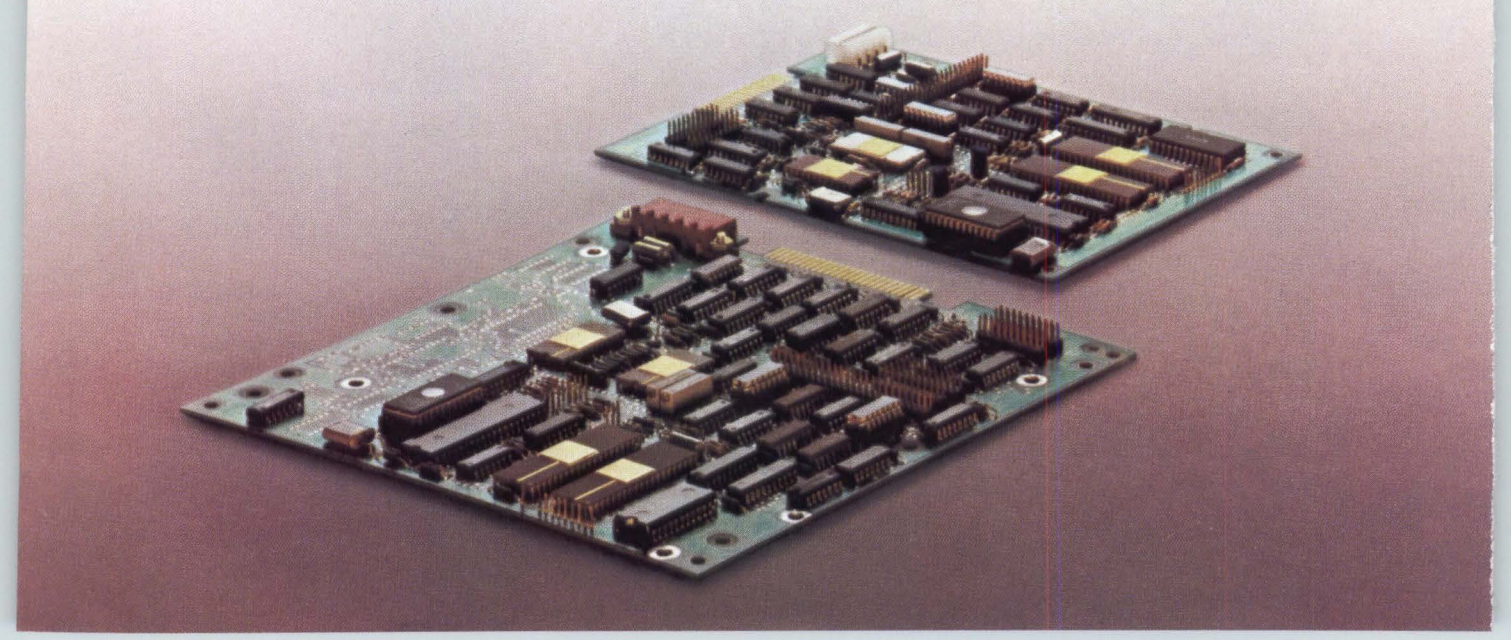
And, of course, like all Shugart controllers the SA1600 Series comes with the industry standard SASI (Shugart Associates Standard Interface). Which means faster systems integration, which means faster evaluation and implementation, which means faster time to market. Since interface protocols and firmware are already in place.

Want to upgrade or switch drives? SASI will accommodate anything we make or plan to make.

And the SA1600 Series is just as accommodating. They'll handle SA1400 commands, yet give you improved error detection, better speed and buffering, and automatic bad spot reallocation.

The SA1600 Series Controllers. Better performance, higher reliability, and lower cost.

Congratulations are definitely in order.



System scans images

(continued from page 48)

white level threshold, and the adjacent pixel controller are under software control.

Another system element, the Three Rivers Computer (Pittsburgh, Pa) minicomputer is a 16-bit microprogrammed TTL bit-slice processor. It has 1M-byte RAM memory, 24M-byte Winchester disk, and 4k or 16k x 48-bit writable control store. The processor provides a 32-bit virtual address space, operating system support for multiple display windows, a hierarchically structured file system, Pascal and FORTRAN compilers, and Ethernet support. Output to the minicomputer from the interface circuitry is 2M bps via a DMA controller, in 64-bit packets.

In addition, system software provides for camera control, manipulating image data, and maintaining an image data base. While Data-Stat does not directly provide image-manipulation software, one system user has configured it to do automatic circuit board checking by comparing the image of a board under test to an image of a properly assembled board. After a bit-by-bit comparison, the differences are shown on a monitor. Thus, the inspector can identify problems quickly and accurately.

A high resolution (768- x 1024-pixel, 65-MHz) CRT, as well as an electrostatic or laser printer provides visual output to an opertor. With 1000-line/min maximum print speed, the V-80 electrostatic printer from Versatec (Santa Clara, Calif) prints 132 columns/in horizontally and 8.5 lines/in vertically, with a 16 x 16 dot matrix of 0.08″ x 0.08″ (0.2- x 0.2-cm) chars in printing mode.

In plotting mode, it offers a 200-dot/in resolution, both horizontally and vertically, at 1″/s. Maximum plot width is 10.56″ (26.82 cm), and the nominal dot size is 0.005″ (0.127 mm).

The Canon laser printer is a desktop plain paper graphics page printer. A special interface allows dot addressability, providing multiple fonts, lines, halftones, and other graphics. Print speed is 10 letter-sized pages/min, and paper is held in a 190-sheet cassette. Printing is done by a combination of electrophotography and semiconductor laser scanning, and development is by a liquid dry toner.

Peripherals include a 768 x 1024 raster scanned graphics display, a 1M-byte floppy disk, a keyboard, a graphics tablet with 4-button cursor, and IEEE 488 (GPIB) and RS-232 interfaces.

Including camera, DMA interface, minicomputer, and video display, a basic AUDRE system costs less than $70,000. Beginning last month, delivery is 60 days ARO. The electrostatic printer/plotter costs $9500; the laser printer/plotter is $22,500. **Data-Stat Co**, 1081 Alameda, Suite 103, Belmont, CA 94002.
Circle 316

INTEGRATED CIRCUITS

CRT controller chips add display color

Two large scale integrated circuits extend the capabilities of Signetics Corp's CRT controller family to full color displays for medium and high performance applications. The SCN2674 Advanced Video Display Controller (AVDC) and the SCB2675 Color/Monochrome Attributes Controller (CMAC) chips provide bit-mapped graphics for a variety of applications such as personal and small business computers, stand-alone terminals and workstations, and word processing systems.

The AVDC has vertical and horizontal timing signals for both interlaced and non-interlaced raster scanned CRTs. It is available with either 2.7- or 4-MHz character rate, and is programmable for various display needs. The AVDC can display 1 to 256 characters/row, with 1 to 16 raster lines/character row. It can also display 1 to 128 character rows/frame, allowing the generation of almost any desired screen format. For instance, it allows a low resolution display of operating parameters for an engineering application, to a full text page (88 characters x 66 lines), or a traditional printout page (132 characters x 66 lines). Double-height and double-width character output allow highlighting and special displays, similar to those possible with many brands of dot matrix printers.

A bit-mapped graphics mode, together with programmable horizontal and vertical synch generators and up to 64K bytes direct RAM addressing for multipage operation, provides facilities for building and manipulating large and complex graphic displays. Flexible cursor controls and attributes, along with automatic RAM wraparound, split screen, and bidirectional smooth scrolling, let the designer create a variety of display styles easily, duplicating the look and feel of familiar terminals.

The AVDC display control generates linear addressing for up to 16K bytes of display memory (up to four 16K banks can be switched via multiplexing on two of the address lines). Internal comparators limit the portion of memory displayed to programmed values.

Four common display buffer memory configurations are supported: independent, transparent, shared, and row buffer modes. The first three modes use single- or multiple-page RAM, and differ primarily in the way data are transferred between RAM and the CPU. The row buffer mode uses a shift register or small RAM, updated in real time, to contain the appropriate display data.

In independent mode, data are transferred from the CPU to memory via a bidirectional latched port controlled by the read data buffer, write data buffer, and buffer chip enable lines. This mode provides a noncontention type of operation and does

(continued on page 60)

CRT controller chips

(continued from page 59)

not require address multiplexers. Data transfers occur during blanking intervals and do not disturb the visual display.

In shared and transparent modes, the display buffer RAM is located in the CPU's memory space, and is directly addressed by the CPU. In both modes, the CPU accesses the display buffer via 3-state drivers.

The AVDC, in transparent mode, delays access to the buffer until a horizontal or blanking interval occurs, thus causing minimal display disturbance. In shared mode, it blanks the display immediately and grants the CPU immediate access to RAM. In row buffer mode, the AVDC halts the CPU and transfers a row of character data from system memory to the row buffer memory. It then releases the CPU and proceeds to display the row.

The other chip, the CMAC, provides control of visual attributes on a character-by-character basis for both color and monochrome displays. There are eight possible colors for the foreground (characters) and background, as well as a luminance output for an external color set or monochrome monitor.

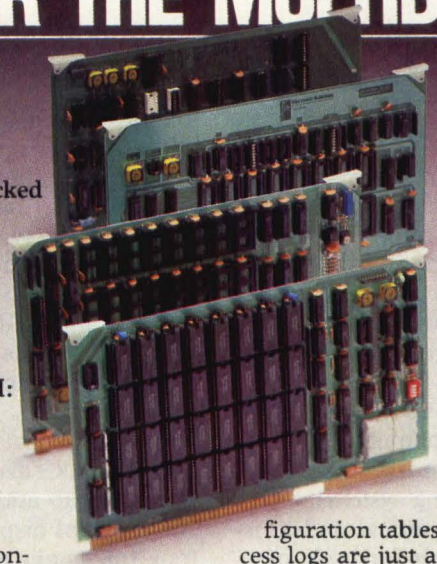
Monochrome mode provides reverse video, blanking, highlighting, and two user-defined attributes. The screen background can be programmed to be either dark (black) or light (gray).

The CMAC is available in 2 standard speed versions: 18- and 25-MHz video dot rate, although higher speed versions can be obtained on a special order basis. It also provides VT100 emulation, with 4 video intensities (2 TTL outputs) in monochrome mode, and 8 foreground and background colors (3 TTL outputs) in color mode.

A minimum CRT color terminal configuration consists of the SCN2674, the SCB2675, an SCN2670 display character and graphics generator, an SCN2671 programmable keyboard and communications controller, a single-chip microcomputer, display buffer RAM, and a few ICs for miscellaneous address decoding, interface, and control.

Packaged in either a 40-pin plastic or ceramic DIP, the AVDC is available now. In plastic packaging, it is priced at $17 (quantity-100). The CMAC is also available now. In plastic, the 25-MHz version is priced at $21 (quantity-100). Signetics has also announced the signing of an alternate source agreement for all members of the 267X family. **Signetics Corp**, 811 E Arques Ave, PO Box 409, Sunnyvale, CA 94086. **Circle 317**

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Electronic Solutions has non-volatile system memory cards in sizes and prices just right for your system. Take a look at this sample of memory cards—all designed specifically for the Multibus:

CMOS RAM: Make use of low-power CMOS RAM with the RAM-C series. Choose from 8K up to 64K bytes with 170 hrs. of NiCd battery backup on board. All have 8/16 bit data paths and 20 bit addressing. The unpopulated board price is only $295 (singles) or $225 in 100's.

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CIRCLE 35

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ncc '83 close-up

The best strategy for wresting top performance from many of today's computer based systems boils down to making the whole greater than the sum of its parts through resource sharing. VLSI circuitry is concentrating local intelligence and tremendous processing power in workstations, peripherals, and memory systems of all descriptions. The next order of business for many system integrators is to incorporate heterogeneous system elements into advanced voice/data communication networks.

Success for the system integrators in an era that links computer applications so closely to telecommunication hinges on industry-wide confirmation of communications conventions. One such effort, the Reference Model for Open Systems Interconnection (OSI), will be reviewed in NCC's Technical Program (*Computer Design*, April 5, 1983, pp 79-90). Tying intelligent peripheral interfaces into system architecture will account for an important part of the discussions on computer communication networks and distributed processing.

On the following pages, *Computer Design* previews many products to be shown for the first time at the 1983 National Computer Conference, May 16 to 19, in Anaheim, California. If early gleanings present an accurate picture of the exhibit as a whole, manufacturers are reading the signposts carefully. Among this year's product introductions, for instance, computer peripherals—particularly multimode terminals—outnumber other categories two to one. Data communications and memory releases follow suit, second in numbers and allied in purpose.

Dedicated database and parallel multiprocessing concepts are rapidly developing into flexible, adaptable systems. Technical sessions will spotlight progress being made in realtime parallel processing with talks on reconfigurable architectures for VLSI processing arrays (Politecnico di Milano, Milan, Italy), conflict-free memory allocation for associative data files (University of Nebraska/Dynamic Computer Architecture, Inc, Lincoln, Neb), and reconfigurable fault-tolerant multicomputer networking (Ballistic Missile Defense Advanced Technology Center/University of Nebraska/Dynamic Computer Architecture, Inc, Lincoln, Neb).

Research database machine topics will cover reconfigurable VLSI architecture for a database processor (Carnegie-Mellon University, Pittsburgh, Pa), implementing set theoretic relational queries using highly parallel index processing hardware (Michigan State University, East Lansing, Mich), and cost-effective ways to improve database computer performance (Naval Postgraduate School, Monterey, Calif).

Flexible hardware and ergonomic peripherals aside, however, software technology will ultimately determine how comprehensive the human/computer interface will be. The U.S. Department of Defense is organizing a software program to complement its VHSIC and Ada efforts. Its goal is to make software more productive, reliable, and adaptable.

Concurrent with the Technical Program at Anaheim's Marriott Hotel, a series of Professional Development Seminars will be conducted at the Hilton on the Park. In tune with this year's conference theme on "The Emerging Information Age: Computers, Communications, and People," 13 full-day and 9 half-day seminars will track technical trends, office automation strategies, and industry management issues. Talks span a range of topics concerning information processing professionals, including computers and the law, integrated data/word processing, computer graphics, data analysis, productivity, and project management. Separate advance registration is required.

On Monday, May 16, John P. Imlay, Jr, Chief Executive Officer of Management Science America, Inc, will deliver NCC's Keynote Address at the Marriott Hotel. His talk, "The Information Transformation—A Study in Survival," will survey computer manufacturing, communications, services, software, office automation, and personal computers. After considering the impact of these technologies on people, politics, and profits, Imlay will discuss the quality of life he envisions for the 21st century. In addition, the Harry Goode Memorial Award honoring outstanding contributors to the information processing field will be presented at the Keynote session.

Howard Hathaway Aiken and the Harvard Computation Laboratory are the subject of Pioneer Day, Wednesday, May 18, at the Marriott Hotel. Technical sessions will analyze Aiken's original system concept and how it evolved in the Mark I through Mark IV computers. Architecture, components, programming techniques, and functions of these machines will be reviewed, with a retrospective on how electromechanical techniques like relays and counters gave way to electronic technology like diode logic and magnetic storage. Then the focus will shift to the Harvard Computation Laboratory and Aiken's work there in numerical methods, switching theory, component design, and computational linguistics.

IEEE-488

You won't find this kind of software versatility anywhere else

When it's time to buy an Instrument Controller/Computer for your next automated test system, software is one of the most important considerations. And that's the reason you should look to Fluke for PASCAL, FORTRAN, two kinds of BASIC and Assembly software. Languages designed to make your system building task easier. Here's how:

Our BASIC is anything but

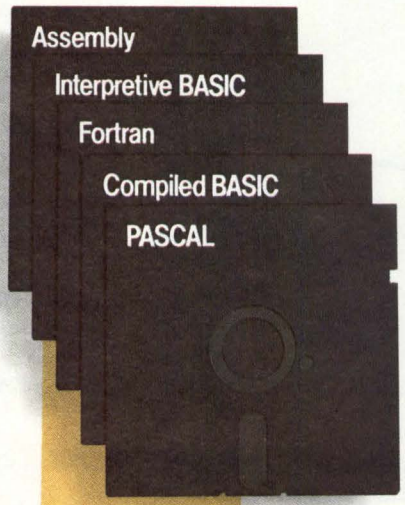
The 1720A comes standard with an interpretive BASIC. It, along with the optional Compiled BASIC, features 28 extensions specifically written to control IEEE-488 programmable instruments. For instance, Fluke BASIC has 7 types of interrupts to signal a variety of external events. We've written the code and embedded it in the language so you don't have to.

Plus, to take full advantage of our mass storage peripherals, this BASIC utilizes Virtual Arrays, a software feature usually found only on larger, more expensive systems.

For more complex tasks—try our new PASCAL

Many programmers favor PASCAL because of its ability to easily support complex data structures. Fluke's PASCAL combines this feature with three extensions which tailor the language to the programmable instrument environment. These extensions are:

- Real-time run mode that allows the 1720A to react to any external asynchronous event.
- Seventeen IEEE-488 predeclared bus procedures imbedded in the language for simplified programming.
- Powerful file handling capabilities that allow the user to take full advantage of Fluke's Virtual Arrays memory system.

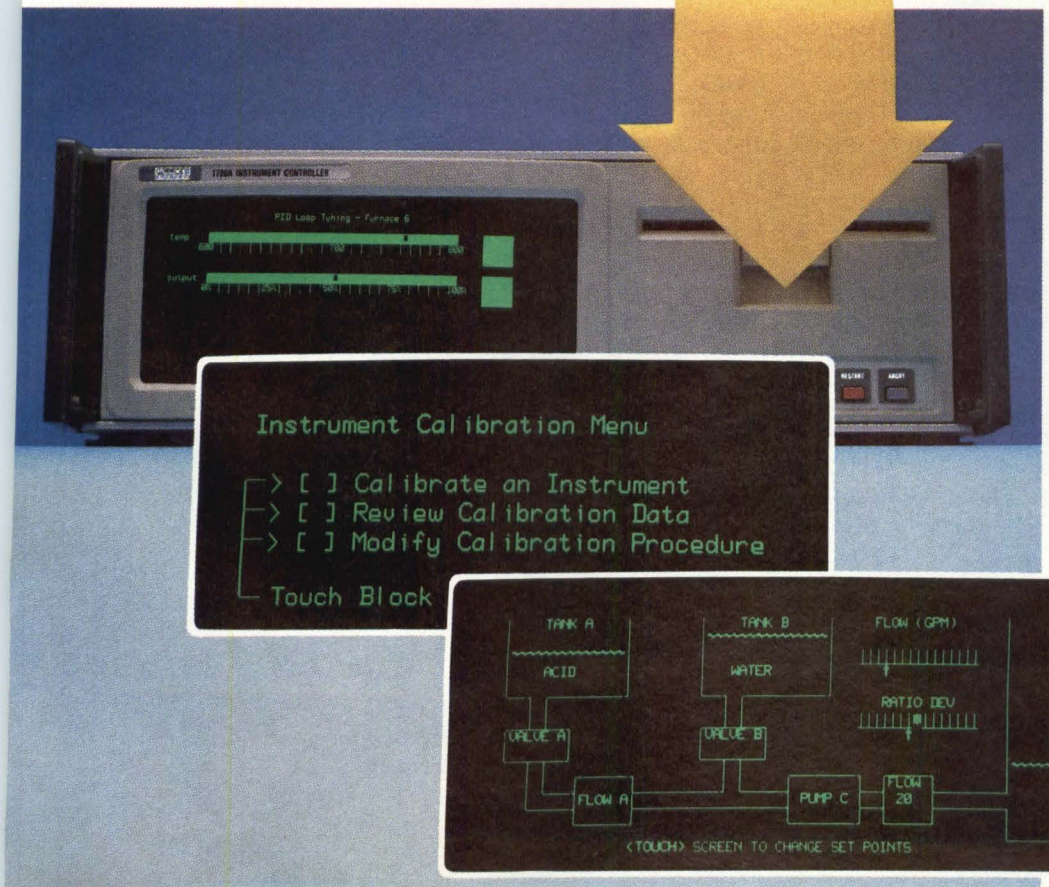


Special Edition FORTRAN and Assembly Languages

Our FORTRAN and Assembly have all the features of these standard programming languages, but with a little extra. Built-in routines allow use of the IEEE-488 bus and other convenience features. And with our BASIC's linking feature, you can combine a FORTRAN or Assembly routine with any BASIC program. You'll save time in programming and running your systems.

Find out more

For more information on these languages or the Fluke Instrument Controller family, contact your local Fluke Sales Engineer, write to us at the address below, or phone us direct at **1-800-426-0361.**



1720A Instrument Controller. Now with Compiled BASIC, FORTRAN and PASCAL

IN THE U.S. AND NON-EUROPEAN COUNTRIES:

John Fluke Mfg. Co., Inc.
P.O. Box C9090, M/S 250C
Everett, WA 98206
(206) 356-5400 Tlx: 152662

IN EUROPE:

Fluke (Holland) B.V.
P.O. Box 5053, 5004 EB
Tilburg, The Netherlands
(013) 673973, Tlx: 52237

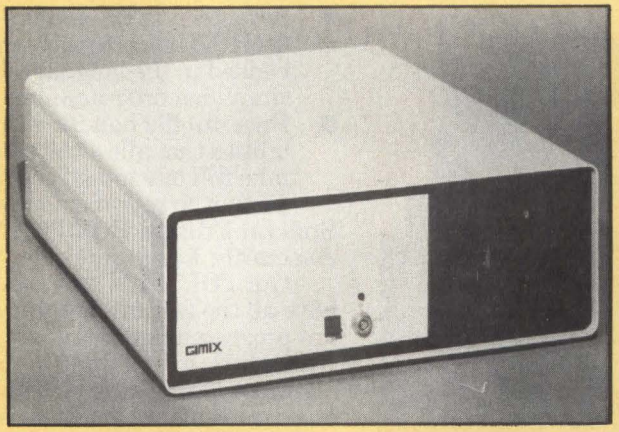
FLUKE®

For more information circle no. **37**

ncc '83 product preview

microprocessors/microcomputers

Multi-user microcomputer



GMX III 6809 features the GMX III CPU board, OS-9 GMX III multi-user, multitasking operating system, and intelligent I/O processor board. The CPU board provides high speed memory to memory DMA transfers, automatic task switching on interrupts, operating system calls for higher system throughput, and a time-of-day clock with battery backup. To prevent system crashes caused by errors in individual user's programs, the system has fully protected user modes with illegal instruction and out of range memory reference trapping and write protection. Hardware also includes 256K bytes of static RAM, a 40M-byte (unformatted) 5¼" Winchester disk, a 1M-byte (unformatted) 5¼" floppy disk, and 3 RS-232-C I/O ports. Power is provided by a constant-voltage, ferro-resonant supply with sufficient reserve capacity to support a fully expanded system. Hardware options include memory expansion to 1M byte, nonvolatile battery backup RAM, additional mass storage, and I/O ports for terminals and peripherals. The UNIX-like OS-9 operating system includes debugger, editor, and assembler. Available software includes BASIC09, Pascal, COBOL, and C. ***Gimix, Inc***, 1337 W 37th Pl, Chicago, IL 60609. **See at Booth P7946** **Circle 201**

6809 based single-board micro

Targeted for dedicated control, protocol conversion, instrumentation, communications, and robotics applications, the 6809 control module is built on a single 4.5" x 6.5" (11.4- x 16.5-cm) card. Microprocessor, watchdog timer, realtime clock, 2 RS-232 serial ports, 4 parallel ports with handshaking, and up to 64K bytes of RAM and EPROM reside onboard. The controller is compatible with the company's serial I/O, parallel I/O, IEEE 488, driver/sensor, floppy disk interface, analog interface, parallel breadboard, console I/O, cassette, and counter/timer modules. Development software for the 6809 is available; CMOS RAM modules provide additional memory. ***Wintek Corp,*** 1801 South St, Lafayette, IN 47904. **See at Booth S5029** **Circle 200**

Computer kit

PC-1250 uses Extended BASIC programming with DIM, STRING, INKEYS, and other commands and statements. The 8-bit CMOS CPU reduces power consumption for extended battery life. With 24K bytes of ROM and 2.2K bytes of RAM, including a 1.7K-byte user area, users can write or load long programs. There are 18 reversible keys for defining frequently used commands, statements, and mathematical functions, with a typewriter key layout and 10 large numerical keys. Memory Safe Guard protects stored information even after the unit is turned off. A special pass code function limits program access to only those who know the code. A 24-digit dot-matrix display and a reverse/program/run mode selector are provided. The optional CE-125 integrated printer/microcassette recorder provides program loading/saving and printout capabilities. ***Sharp Electronics Corp***, 10 Sharp Plaza, PO Box 588, Paramus, NJ 07652. **See at Booth P7204** **Circle 202**

NOTE: "A" series booths are located in Anaheim Convention Center's Arena, "N" series in the North Hall, "S" series in the South Hall, and "W" series in the Southwest Hall. "P" series booths are in the NCC Pavilions adjacent to the Registration area. "D" series booths are located in the Disneyland Hotel Convention Center. Shuttle buses will run between the two exhibit locations and all convention hotels.

256K ROMs ON TIME.

NO IFS, ANDS, OR BUTS.

Last year at NEC Electronics, 99.5% of all our ROM deliveries were on-time. A tradition we intend to continue.

We're delivering 256K ROMs now.

Our 256K NMOS ROM offers fast speed and low power. Maximum access time of 250 ns. Maximum power consumption of only 40 mA in active mode. A 32K x 8 bit organization. I/O's that are TTL-compatible. Industry standard pin-outs. And a $+5v \pm 10\%$ power supply.

Our word is as good as our ROMs.

ROMs on-time from NEC is no surprise. We can offer on-time delivery because of our fully automated assembly. It insures consistent quality and makes fast turnaround possible.

For more information about our 256K ROMs and the company that stands behind them, write or call NEC Electronics U.S.A. Inc., Electronic Arrays Division, 550 E. Middlefield Rd., Mountain View, CA 94043, (415) 964-4321. Woburn, MA (617) 935-6339; Melville, NY (516) 293-5660; Columbia, MD (301) 730-8600; Pompano Beach, FL (305) 785-8250; Southfield, MI (313) 352-3770; Rolling Meadows, IL (312) 577-9090; Dallas, TX (214) 931-0641; Orange, CA (714) 937-5244; Cupertino, CA (408) 446-0650.



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NEC Electronics U.S.A. Inc.
Electronic Arrays Division

We're taking on the future.

CIRCLE 38

ncc '83 product preview

microprocessors/microcomputers

32-user microcomputer system



Ensign is a fast 5-processor computer system. Main CPU is a Motorola 68000 running at 8 MHz with no wait states. Two 6801 processors handle all serial I/O for up to 32 users. This frees the main processor from communications overhead. A 6-MHz Z80B supervises all disk and tape I/O, allowing heavy disk/tape I/O without CPU degradation. Another 6-MHz Z80B is used for memory management, eliminating CPU overhead. Result of the multiprocessor architecture is performance that rivals 16-bit minicomputers and small 32-bit mainframes. Both OASIS-16 and UNIX operating systems are supported. The system supports up to 8M bytes of main memory and up to 512K bytes per user, over 1G byte of SMD type disk capacity, and cartridge and 9-track reel to reel tape. It is available in desktop or rackmount cabinet. ***IBC/Integrated Business Computers***, 21592 Marilla St, Chatsworth, CA 91311. **See at Booth P8001** **Circle 203**

LSI-11/23 based microcomputer



A22 systems contain an 8″ RX02 compatible floppy drive and a 10.4M-byte RL01/RL02 compatible 5¼″ Winchester drive. Software compatible with RT-11, RSX-11, RSX-11M, RSX-11 PLUS, UNIX, and TSX-PLUS, the 7″ (17 cm) high microcomputer is supplied in either a rackmountable configuration or a desktop version. The chassis contains an 8-quad slot Q-bus card cage that accommodates standard DEC dual or quad boards.

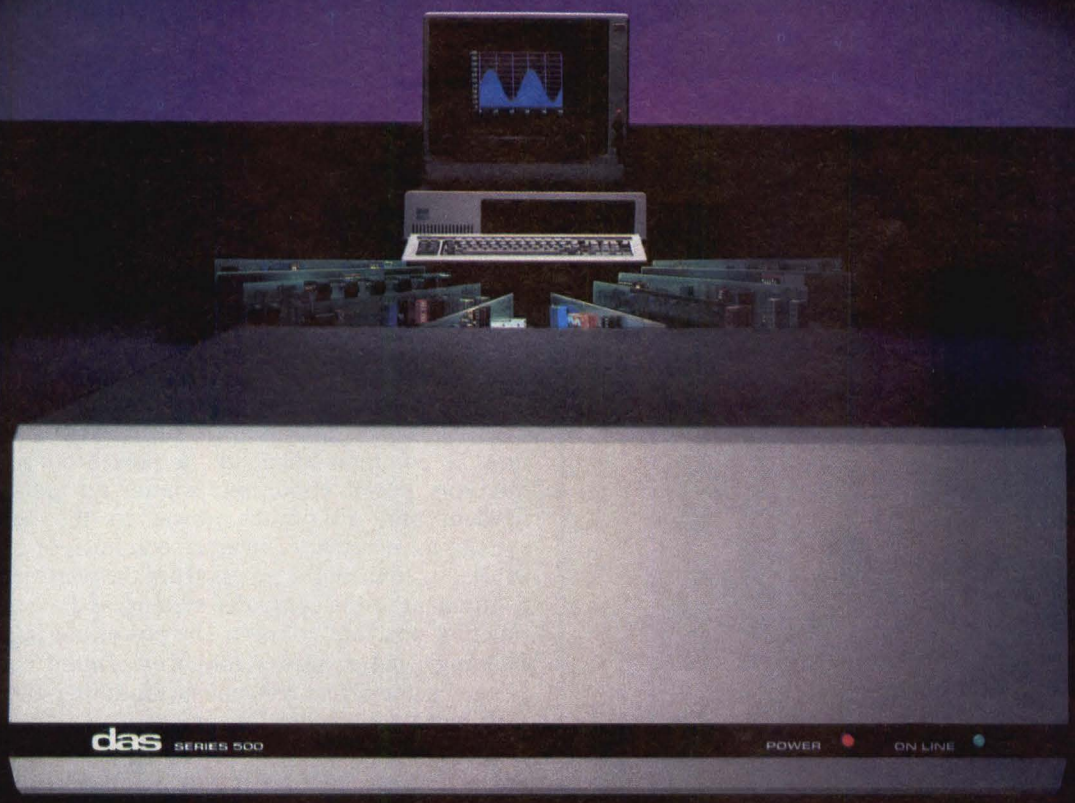
After sufficient power is taken to run the disk drives, 30 A are available for the card cage area. A minimum configuration contains 256K bytes of memory; systems are also available with 1M-byte memory. Maximum memory is 4M bytes. ***Dataram Corp,*** Princeton Rd, Cranbury, NJ 08512. **See at Booth S5284** **Circle 204**

16-bit microcomputer system



IBM PC compatible 1600 series microcomputers use the Intel 8086 microprocessor at 8 MHz to operate at up to 4 times the speed of the IBM PC. Networking options allow up to 64 8- or 16-bit microcomputers and hard disk add-on storage to be linked together. A basic system consists of 128K bytes of RAM, 1M byte of 5¼″ floppy disk storage, and 12.5M bytes of hard disk storage. Internal memory is expandable to 512K bytes. Eight expansion slots permit the addition of peripherals. Two hard disk add-ons, the File 10 and File 40, provide optional mass storage. These free-standing units provide 12.5M and 40M bytes of additional storage, respectively. ***Eagle Computer, Inc,*** 983 University Ave, Bldg C, Los Gatos, CA 95030. **See at Booth D2014** **Circle 205**

THE NEW DAS SERIES 500 FOR THE IBM PC:



THE DATA ACQUISITION & CONTROL SYSTEM YOU SHOULD CONSIDER OVER A MINI. EVEN IF MONEY IS NO OBJECT.

Let's say you have enough money to buy nearly any data acquisition and control system you might want. What will you choose?

If sheer power is your main requirement, you might choose an expensive minicomputer system. But, then again, you might just as well choose the new DAS Series 500.

Simply plug the Series 500 into any off-the-shelf IBM Personal Computer and you'll have up to 336 channels of analog input, 60 channels of analog output and 192 channels of digital I/O (even AC/DC device control). And with measurement speeds as high as 25,000 analog data points per second, and true 12 or 14 bit precision, you'll have enough power and accuracy for the most demanding applications.

If you need flexibility, you'll want to compare other, more costly systems to the fully modular Series 500. It comes supported by an extensive library of integrated plug-in modules that let you custom tailor almost any combination of inputs and outputs, digital or analog. And do so almost instantly.

So the Series 500 is ideal for hundreds of applications in product test, process control and energy management; in psychology, biology, analytical chemistry and neuroscience.

If ease of use is high on your list, consider this: Only the Series 500 comes equipped with the advanced, integrated Soft500 software package. With it, you can set up, collect, store, control, display and analyze, all with a few simple BASIC commands.

In fact, Soft500 makes programming so easy, you can be up and running with your Series 500 the same day you get it. Even if you're not a computer expert.

Now compare advanced features. Like exclusive foreground/background software architecture that lets you analyze data while you collect it. Like the real-time clock/calendar and precision interval timer. Or the tremendous range of signal conditioning options, including software selected gain and offset, amplification from millivolt levels, and provision for direct connection of thermocouples, strain gauges and RTDs.

These are features you might not get elsewhere, no matter how much money you spend. But then, why spend all that money?

Because for less than $6000 you get both the advanced capabilities of the DAS Series 500, plus an IBM PC* (which incidentally, you can still use to do all the other things a PC does so well).

For complete information on the DAS Series 500 data acquisition and control system, write to us at Data Acquisition Systems, Inc., 349 Congress Street, Boston, Massachusetts 02210. Or call us at 617 423-7691.

das

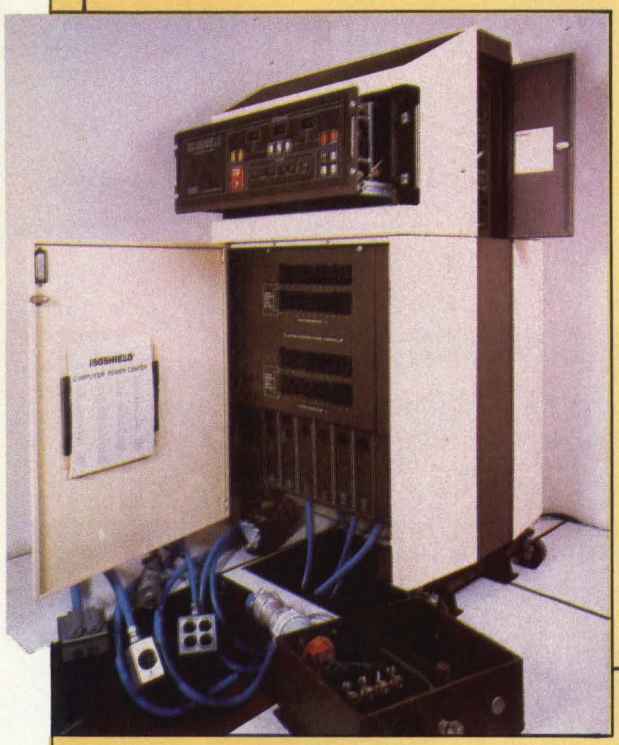
*IBM PC purchased separately. Also available for the Apple II. IBM PC & Apple II are registered trademarks.

CIRCLE 39

ncc '83 product preview

power sources & protection

Power distribution systems

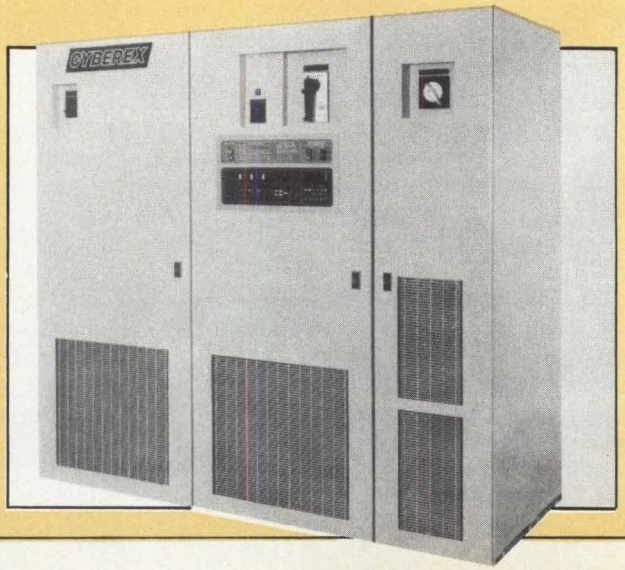


Designed to meet requirements over a range of power regulation and protection applications, line consists of 3 systems: Guardsman, Isoshield ®, and Isoreg ®. Features include high visibility power monitor panel; Pentacore transformer, front access wiring cabinet, independent outlet and circuit breaker panels, and external rotary tap changer. Each system incorporates 3 common elements: a power console that monitors power condition, sounds an alarm when needed, and distributes power to the computer system as necessary; flexible conduits or shielded cables, to connect the power from the console to each component in the computer system; and a watertight junction box that connects the power console to the building's major power line. Guardsman computer power center offers convenient mounting and power distribution.

Isoshield combines isolation transformer characteristics with a Faraday shield to isolate and protect computers and other sensitive electronic equipment from voltage spikes and electrical noise that can cause interruptions and data loss. Isoreg protects against voltage sags, surges, spikes, electrical noise, brownouts and power outages lasting less than 1 cycle. The system consists of 2 modules: the power console and the computer power conditioner, which combines the functions of an Isoshield transformer and a voltage stabilizer. The complete line is available in 1- and 3-phase models ranging from 22.5 to 225 kVA. *Isoreg Corp,* 410 Great Rd, Littleton, MA 01460. **See at Booth P7017** **Circle 206**

Uninterruptible power system

Transistorized system, in 60 or 415 Hz models, supplies high efficiency and reliability and fast response to power fluctuations. Easy maintenance and maximum safety are provided through the use of removable dead front isolation panels that minimize possible shock exposure. A highly visible mimic readout, located at the front of the cabinet, monitors all UPS operations. Digital metering displays system performance data including voltage, current, and frequency. The units need 20% less floor space than comparable models; front-only access eliminates need for back and side space requirements. *Cyberex Inc,* 7171 Industrial Park Blvd, Mentor, OH 44060. **See at Booth N4501** **Circle 207**

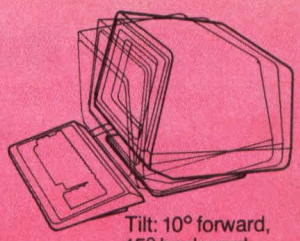


The VISUAL 100 video display terminal is 100% compatible with the DEC VT 100 terminal from identical software right down to the layout of the keys and the sculpturing of the keyboard.

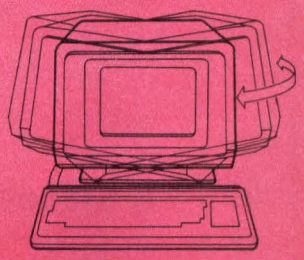
But when it comes to ergonomics, the VISUAL 100 is something else! For example, the VISUAL 100 is designed in lightweight plastic that can easily be swiveled and tilted for maximum operator comfort. A detached, low profile keyboard, and 12″ or 14″ non-glare screen are just a few of the other human engineering advantages of the VISUAL 100.

The Advanced Video package and current loop interface that are optional with the DEC terminal are standard with the VISUAL 100. Plus we've added an optional Buffered Printer Interface with independent baud rate, independent parity and printer busy via "XON-XOFF" protocol. And although the VISUAL 100 is a step up from the DEC VT 100, it is priced a step below. Only $1,345 list. Call or write for full details.

Service available in principal cities through Sorbus Service, Division of Management Assistance, Inc.



Tilt: 10° forward, 15° backward



Swivel: 270°

VISUAL 100.

Combines VISUAL'S ergonomic excellence with DEC VT 100® performance.



$1,345

VISUAL See for yourself

Visual Technology Incorporated
540 Main Street, Tewksbury, MA 01876
Telephone (617) 851-5000. Telex 951-539

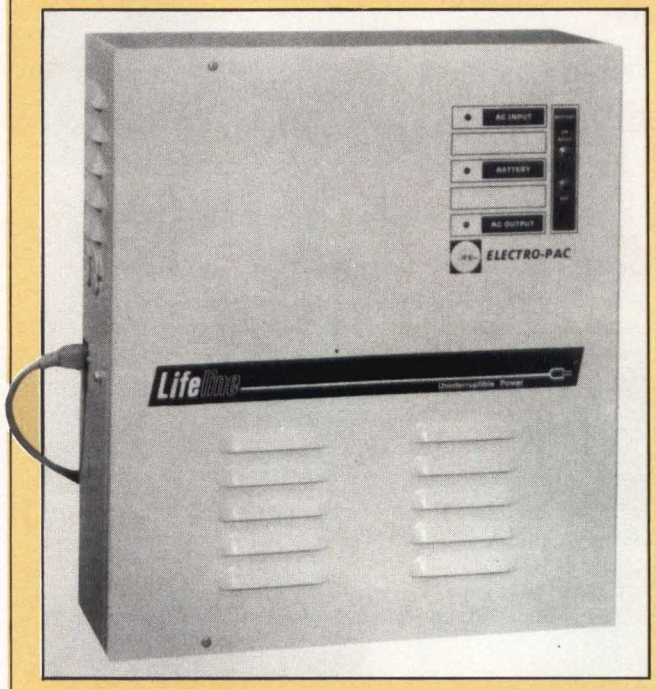
CIRCLE 40

See us at NCC, Booth #S-5350

ncc '83 product preview

power sources & protection

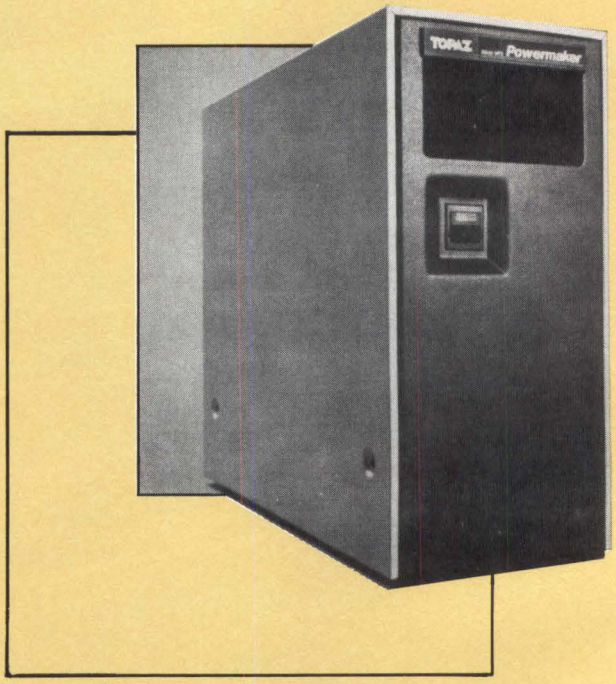
600-VA standby ac power



Lifeline power system was designed to provide clean, noise-free, reliable 5 A of 120-V sinewave power for computers, memories, disk systems, communication terminals, and security systems. Designed for easy installation by nontechnical personnel, the unit requires no initial startup adjustments. The system design provides voltage regulation and filtering at all times, an inverter that supplies power during power outages, and a charger that keeps the batteries at proper float and recharges the batteries after a power outage. There is no transfer time and, therefore, no interruption of power to the critical load. The output is sinewave with very low harmonic content. The control system continuously monitors the commercial line for voltage levels or frequency ranges that are out of the allowable passband of the computer load. If a deviation is sensed, the computer load is transferred without interruption to the internal inverter. When these disturbances subside and the commercial line returns to normal acceptable operating limits, the critical load is again powered by the line. ***Instrumentation and Control Systems, Inc, Electro-Pac Div***, 520 Interstate Rd, Addison, IL 60101. **See at Booth W6619** **Circle 208**

Microcomputer backup power

Powermaker Micro UPS protects small computers against blackouts, voltage sags, and power line noise. Standard features include maintenance-free lead-acid battery and protection against overcurrent, short circuit, and battery discharge. The unit filters line noise while commercial power stays within computer tolerance, but provides steady sine-wave ac power when supply drops below tolerance. When power returns to normal, the backup system automatically switches back to the power line. Indicator light shows when power is present at the unit's output, whether from the utility line or the system's battery. An alarm sounds when output power is supplied by the battery.



Typical backup times range from 6 to 35 min. Output ratings are 400 and 800 VA. Noise attenuation begins at 10 kHz and is 40 dB minimum over 100 kHz. Transfer time from power line to inverter is 4 ms typ, 10 ms max; for inverter to power line, 2 ms typ, 4 ms max. ***Topaz, Inc, Electronics Div,*** 3855 Ruffin Rd, San Diego, CA 92123. **See at Booth N3539** **Circle 209**

Black and white facts about color graphics.

Fact 1.
Software development is expensive.

Raster Technologies' Model One graphics systems feature software tools that speed application development. Like an integrated local debugger. Command stream translator. Local command execution. A complete HELP facility. And truly easy to use macro programming. These unmatched software tools save you time and money.

Fact 2.
Software redevelopment is even more expensive.

With Raster Technologies' fully compatible Model One family, you can take advantage of the latest hardware without any software rewrites. This means an easy upgrade to a more powerful product while still using the same graphic commands, program development tools and host library. So the application developed for the best hardware today can run on the best hardware tomorrow. Without modification.

Fact 3.
Performance is a lot more than good specs.

Graphics performance goes beyond pixel and vector timing specs. It is the ability to display a complex picture without having to wait. Provide instantaneous interaction between an application program and its user. And efficiently communicate with a host computer. The kind of total graphics performance you should measure before you buy.

Fact 4.
Graphics applications demand flexibility.

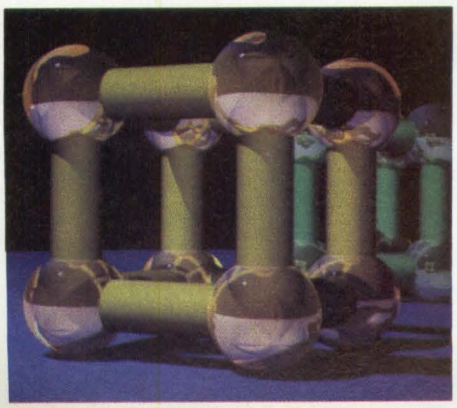
The Model One family from Raster Technologies offers maximum flexibility at the lowest cost. Because it lets the user select the combinations of display resolution, color and refresh rates that are right for that particular application. Factors that are different for every application.

Fact 5.
Graphics technology is moving fast.

Raster Technologies is dedicated to one business: graphics. All our development efforts focus on advancing graphics technologies. With the latest microcircuitry. The newest and fastest microprocessors. The most advanced display list architectures. And the most innovative pipelined multiple processor designs. All to advance graphics capabilities compatibly. And keep today's customers with us tomorrow.

Fact 6.
You should benchmark the Model One.

The Model One/25 features vivid full color imaging performance with 512 x 512 resolution. The Model One/40 features ultra high 1024 x 1024 resolution. The Model One/60 features 100% flicker-free 60 Hz non-interlaced display with 768 x 576 resolution. All support our Advanced Graphics Application Development Firmware and powerful display list package. Put the Model One family to the test.

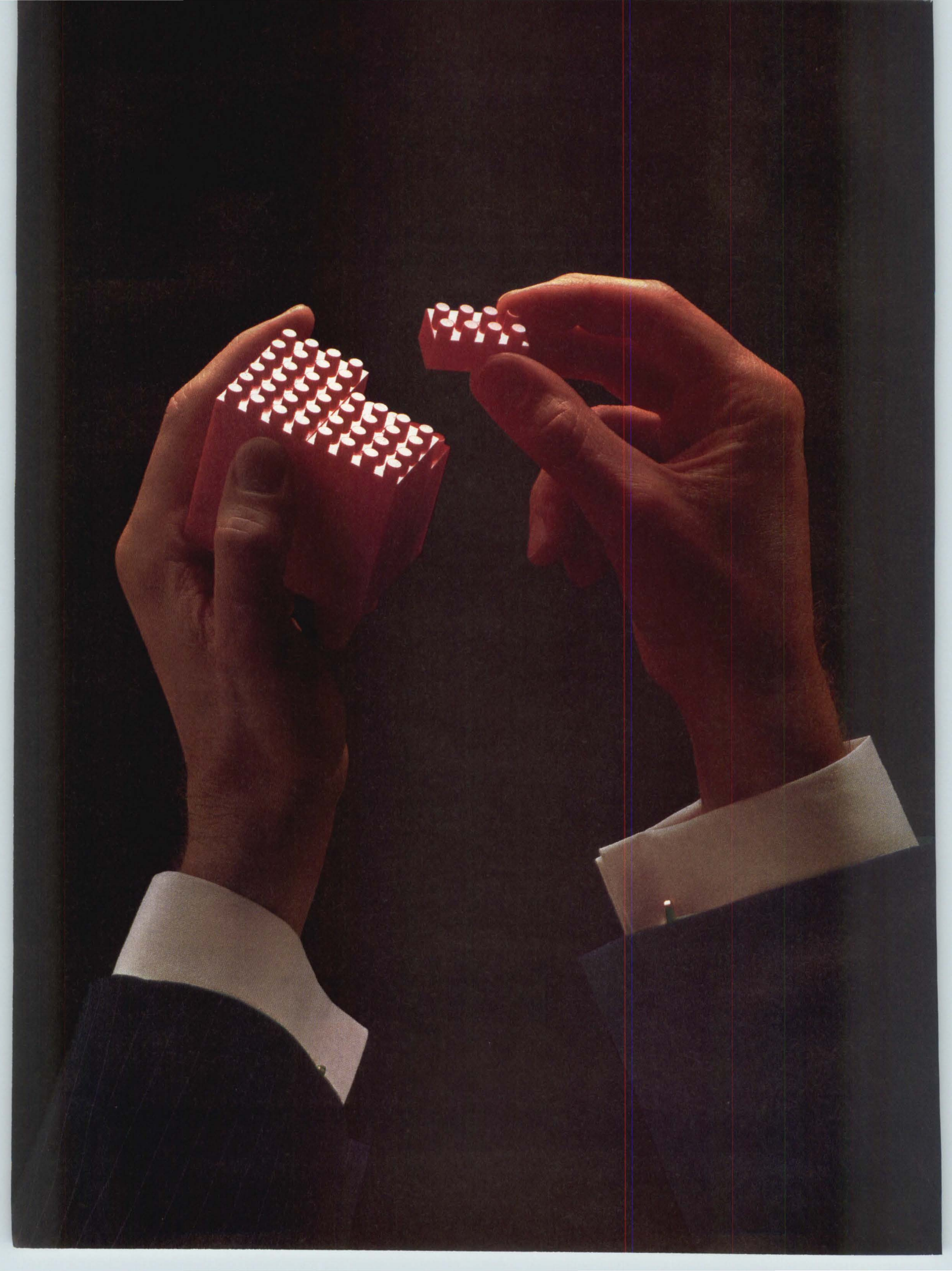


Raster Technologies

The benchmark of computer graphics.

9 Executive Park Drive
North Billerica, Massachusetts 01862
(617) 667-8900
TWX: 710-347-0202

CIRCLE 41



A SYSTEMS APPROACH EVEN A COMPANY PRESIDENT CAN APPRECIATE.

There is one approach to systems that's designed to hold your interest. Whether you're building systems or building a company that does.

Intel's Open Systems approach.

It means that Intel integrated microcomputer-based systems are built on industry standards like the MULTIBUS® architecture and our iRMX™ realtime operating system. And proposed standards like Ethernet* and Xenix*. So there are no proprietary architectures to get locked into. Or major markets to get locked out of.

What's more, you can change your level of integration at any time. To reduce time to market. Or cut costs. Because our advanced microprocessors, peripherals and board level products are based on those same standards. So you'll never have to worry about the new parts not getting along with the old ones.

Open Systems also means that future products will fit quite nicely into our present distributed processing systems. So growth-path compatibility and product upgrades should be a snap.

You'll also be positioned to take advantage of breakthroughs in VLSI, while your competition is still toying with the idea.

When you put it all together with Intel Systems, it clicks: lower risks, shorter schedules, state-of-the-art performance, easier customization, future compatibility, and a solid place to put your money.

And that's something everyone can appreciate.

Whether you're the president of the company, or just a kid on the way up.

To learn more about Intel's Open Systems, attend one of our Executive Seminars. Call us at (800) 538-1876. In California, (800) 672-1833.

Or write Intel, Lit. Dept. Z13, 3065 Bowers Avenue, Santa Clara, CA 95051. And we'll give you the dates of the seminars nearest you.

intel® delivers solutions

*Ethernet is a registered trademark of Xerox Corp. Xenix is a registered trademark of Microsoft, Inc.

See us at NCC, Booth #3910

power sources & protection

5-kVA uninterruptible power



Designed to maintain precise, conditioned ac power in addition to reserve battery backup during total line failure, this UPS operates continuously during normal line power conditions to provide voltage regulation plus isolation from noise and transients. If a total power outage occurs, the unit automatically draws power from its battery reserve to maintain continuous, no-break output. An internal solid state bypass transfer automatically switches the load directly to the utility power line when load demands exceed system overload capacity of 200% for 167 ms. This system maintains phase match between UPS output and bypass line to ensure no-break transfer. Normal operation is automatically restored with correction of overload condition. The unit accepts input voltage fluctuations of 10% to −15% and regulates output voltage to within ±1.5%. It holds output distortion to under 5% of total rms and 3% single harmonic. Models include 60-Hz with I/O at 120 Vac, single-phase 2-wire; 120/240-Vac, split single-phase 3-wire; or 208-Vac, single-phase 2-wire. All units measure 48″ x 40″ x 24″ (122 x 102 x 61 cm), and weigh approximately 1000 lbs (454 kg). ***Sola Electric***, 1717 Busse Rd, Elk Grove Village, IL 60007. **See at Booth N3559** **Circle 210**

Computer grade power systems

Designed for EIA rack, desktop, or wall mounting, the A52CP line requires 80% less space than previous models, making them suitable for laboratories, office, and production areas. These units supply continuous, disturbance-free, computer grade power regardless of the condition of the ac line. Utilizing CMOS logic and highly reliable sine weighted pulse width modulation, they are equipped with electronic output voltage regulation, quartz time base, 120% current limit, and power walk in. ***LaMarche Mfg Co***, 106 Bradrock Dr, Des Plaines, IL 60018. **See at Booth S5560** **Circle 211**

Transient voltage suppressor

Designed to protect against transients and surges that might enter the interface of an unprotected host system, Series T-25 Clipper protects 18 lines. The T-25-3 protects lines 2, 3, and 7; T-25-5, lines 2, 3, 4, 5, and 7; and T-25-10, lines 1, 2, 3, 4, 5, 6, 7, 8, 11, and 20.

All units are designed for serial operation with a baud rate from dc to 19,200. The transient voltage suppressor handles a maximum data signal amplitude of 40 V pk to pk. It has a surge rating of 64 A in each direction. Each unit is available with 2 female, d-subminiature, 25-pin connectors. Double-stick tape is provided on the back of each unit for easy mounting. A 6″ (15-cm) male ribbon cable is optional. ***Dymark Industries,*** 21 Governor's Ct, Baltimore, MD 21207.

See at Booth T7158 **Circle 212**

Backup power supplies

Programmed Power Centers offer efficiency and reliability at all load levels. Available in all standard voltages, they feature built-in paralleling capability for redundancy or expansion without modification. The systems conform to NEMA, IEEE, and ANSI standards. Compact systems with low MTTR, they are suitable for all types of installations that require complete backup power protection. ***Liebert Corp***, 1050 Dearborn Dr, PO Box 29186, Columbus, OH 43229. **See at Booth N3668** **Circle 213**

The more logical way to look inside an IC.

1973 GLOBAL SPECIALTIES CORP. 10th ANNIVERSARY 1983

LTC Logical Analysis Test Kits: everything you need for over 90% of your digital testing.

Everything you need is at your fingertips. Circuit-powered. And easy to use. Ready to read logic activity at a glance, point-by-point or IC by IC. Or to inject digital signals for testing.

Let the LEDs of our Probes, Pulsers and Logic Monitors light the way to answers for your troubleshooting, design and educational needs. The Logical Analysis Test Kit comes in two versions: our $270.00* High-Speed Kit, LTC-2, which captures pulses as narrow as 6 nsec, rep rates to 60 MHz; and our $240.00* Standard Kit, LTC-1, which goes to 50 nsec, 10 MHz. Both include complete manuals, accessories and a compact, custom-molded case. Either way, you've got a strong case for simplified digital testing.

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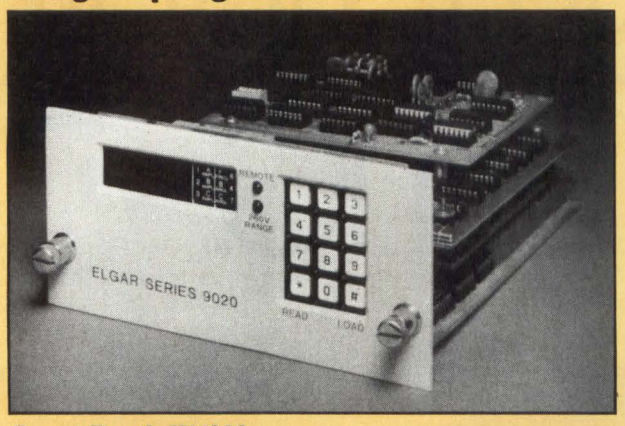
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CIRCLE 43

ncc '83 product preview

power sources & protection

Plug-in programmable oscillator



See at Booth W6083

Six function programming for multiphase ac power source systems is available with the Series 9020 Programmable Oscillator. Three phase amplitudes, 2 phase angles, and frequency can be programmed via GPIB IEEE 488 logic or front panel keyboard. The programmable oscillator includes a 4-digit display that can be recalled from the keyboard. This will display what has been previously programmed or what is being programmed for any of the 6 functions.

The oscillator is capable of up to 0.01-Hz frequency programming resolution with ±0.001% accuracy as well as 0.5° phase angle programming resolution. Optional automatic range change for associated power amplifiers and 0- to 130-Vac/0- to 260-Vac dual voltage range with a 0.1-Vac programming resolution is also included. ***Elgar Corp,*** 8225 Mercury Ct, San Diego, CA 92111. **Circle 214**

AC voltage monitor

A detachable detector module on the Stabiline monitor allows monitoring of 1- or 3-phase power lines. For 3-phase applications, the system monitors all phases; different sag, surge, low average, high average, and impulse levels can be set for each channel. The system can monitor 120-, 208- to 240-, or 480-Vac power lines and can check dc power sources up to 10 V. Since thresholds for each channel can be set independently, 120-, 240-, and 480-V 1-phase lines can be monitored simultaneously. A system consists of a Remotector detector module and a microprocessor based printer/controller module. Threshold limits, calendar and clock settings, and monitor identification number can be entered with push-button keys. The detector can be left at a site to perform its monitoring function; units with identical or different threshold values can be left at various sites. The detector module and printer/controller can both be interfaced to an industry standard modem through an optional modem adapter. This permits communication over a conventional telephone line under Bell System Standard 103B. Ten rates are available with 110- or 300-baud acceptable for telephone line implementation. Data transmission is full-duplex asynchronous. System memory can total up to 98,400 events and retain them for several months under backup battery power. Data are presented in a categorized format, with a summary of the 10 worst events in each category followed by a list of the last 10 chronological events. An additional channel allows monitoring of user-generated signals representing an event in the user's equipment. ***The Superior Electric Co,*** 383 Middle St, Bristol, CT 06010. **See at Booth N4600** **Circle 215**

system elements

Low profile keyboard and keytops

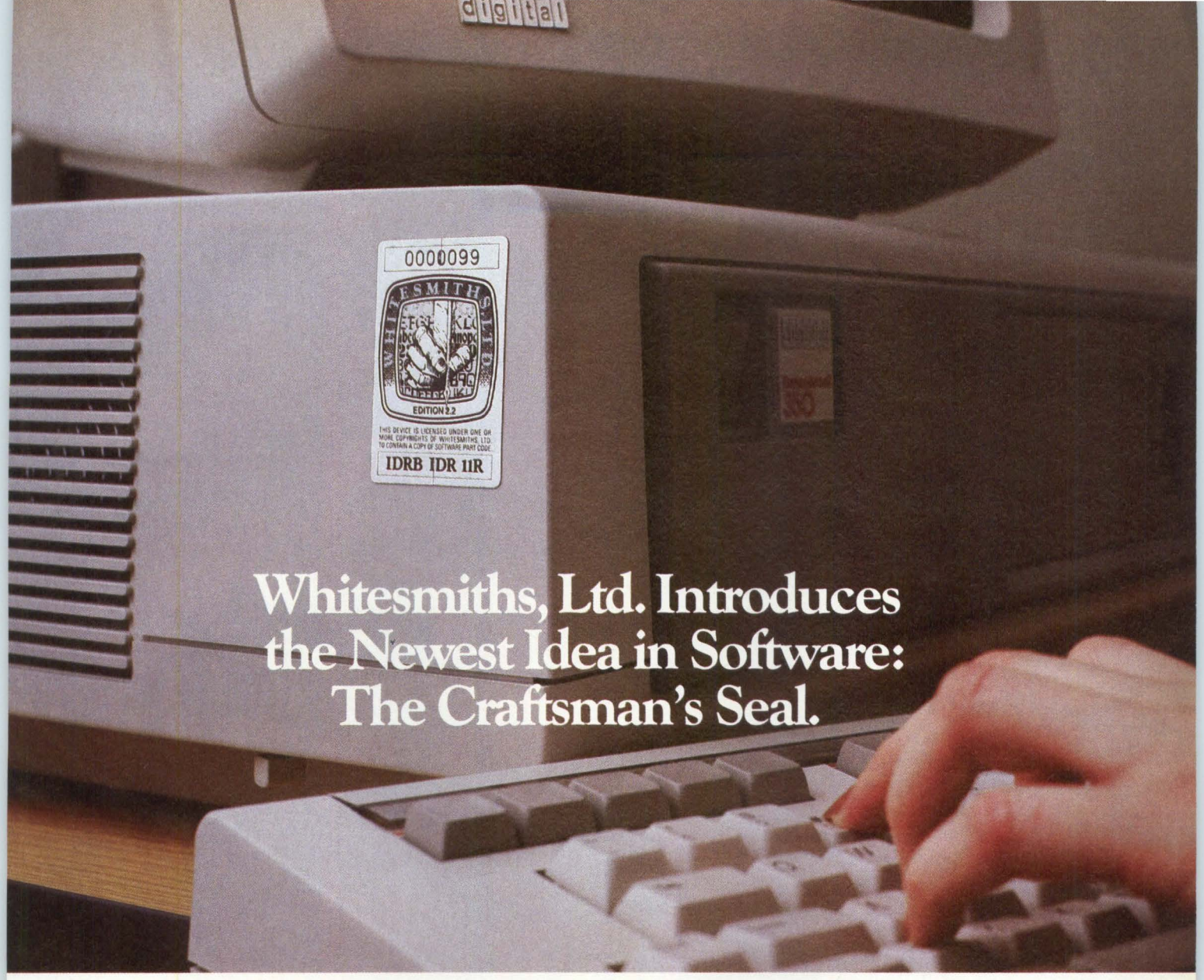


See at Booth N3666

Series FC2500 features solid state ferrite core, linear or tactile feel keyswitches, as well as full surface multistation keytops. The keyboard meets or exceeds ergonomic height restrictions of 30 mm from keyboard base to home row keytop surface. Features include LED indicator, 5-Vdc operation, flexible key assignment, odd or even parity, and serial and/or parallel output as well as selectable baud rates.

The low profile keytops feature full matte finish to reduce reflection, a large surface area for legends, and protection against office environmental elements. The keytops also ensure accurate location of operator's fingers. N-key rollover, and electronic shift lock are also provided, and there is no keyswitch bounce.***Cortron, Div of Illinois Tool Works Inc,*** 400 W Grand Ave, Elmhurst, IL 60126.

Circle 216



Whitesmiths, Ltd. Introduces the Newest Idea in Software: The Craftsman's Seal.

Like the craftsman's seal on a fine work of art, Whitesmiths' Authorization Seal is more than just a means of identification. It represents the pride in workmanship, sense of tradition, and commitment to value on which we have always prided ourselves.

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The Authorization Seal is one more way we can take pride in our products. Once affixed to the machinery on which the software is to run, the Authorization Seal verifies, at a glance, ownership, product code, and the software copyright – all of which reduce order turnaround time and upfront expenses for both OEMs and end-users. No contracts to sign, no documents to read. Just good software, plain and simple.

The Whitesmiths, Ltd. Authorization Seal. It's one more way that we're committed to becoming a software tradition in your time.

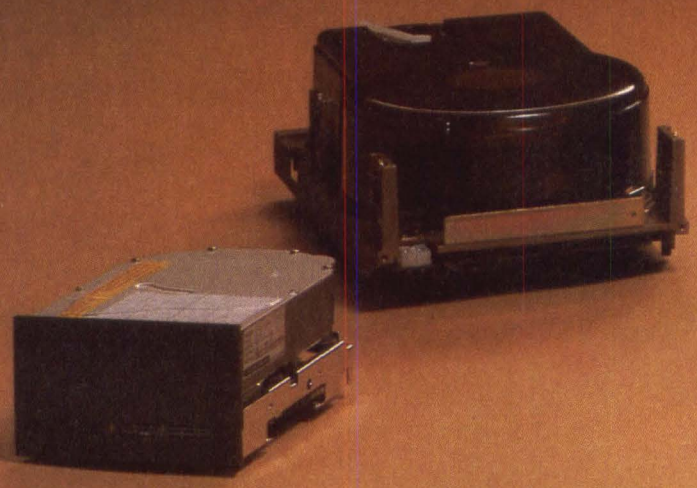


Contact Whitesmiths, Ltd., 97 Lowell Road, Concord, MA 01742, (617) 369-8499 TLX 951708 SOFTWARE CNCM.

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Five definitions of the word quality.



Quality: over 15 years' experience producing disk drives, total vertical integration of manufacturing, and a caliber of product support you can measure by the loyalty of our customers. Quality that is a Fujitsu exclusive. Find it in our complete line of Winchester disk drives.

	5¼-INCH			8-INCH			
MODEL	M2231	M2233	M2234	M2301B	M2302B	M2302BE	M2303BE
CAPACITY (MB)	6.7	13.3	20.0	11.7	23.4	23.7	47.5
AVG. POSITIONING TIME (ms)	95	95	95	70	70	70	70
TRANSFER RATE (KB/s)	625	625	625	593	593	1,200	1,200
INTERFACE	ST506/SA4000			SA4000			
AVERAGE LATENCY (ms)	8.3	8.3	8.3	10.1	10.1	10.1	10.1
RECORDING DENSITY (BPI)	8,020	10,200	10,200	6,100	6,100	12,360	12,360
TRACK DENSITY (TPI)	254	300	300	195	195	195	195
NUMBER OF CYLINDERS	160	320	320	244	244	244	244
NUMBER OF DATA HEADS	4	4	6	4	8	4	8
POSITIONING METHOD	Buffered Stepper			Buffered Stepper			
DIMENSIONS (HxWxD in.)	3.3x5.7x8.0			4.4x8.5x14.0			

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8-INCH		14-INCH			10½-INCH
M2311K	M2312K	M2280K/N	M2284K/N	M2294K/N	M2351
48.3	84.4	84.3	169	335	474
20	20	27	27	27	18
1,229	1,229	1,012	1,012	1,012	1,859
SMD		SMD			Modified SMD
8.3	8.3	10.1	10.1	10.1	7.58
9,550	9,550	5,580	5,580	5,580	12,790
720	720	680	680	850	880
589	589	823	823	1,024	842
4	7	5	10	16	20
Rotary Voice-Coil/Servo Controlled		Rotary Voice-Coil/Servo Controlled			Rotary Voice-Coil/Servo Controlled
5.0x8.5x15.0		9.8x16.4x25.6			10.4x19.0x27.6

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Northwest 408/988-8100 Southwest 714/558-8757
East Coast 617/229-6310 Europe 44-1/493-1138

SEE US AT NCC BOOTH #6478

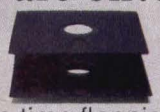
FUJITSU

QUALITY LIVES

CIRCLE 44

A "true" Winchester memory system with no buts about it.

Dual floppies are ok...



but micros have already outgrown low-capacity, poor-reliability, slow-access-time floppies.

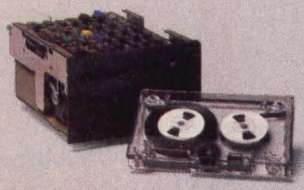
Winchester with floppy is better...

but it's really just a glorified floppy memory system.



Winchester with tape... is as good as floppies...

but tape cartridges aren't really right—except for routine archiving.



DMA's 5¼" Winchester solution:

A memory system that makes sense instead of problems. The Micro-Magnum™ fixed/removable disk drive has mass storage, data portability, and backup in one device.

The Micro-Magnum 5/5: 5¼" fixed Winchester—backed by a reliable 5¼" industry-standard removable Winchester cartridge.

With 6.5 MBytes fixed and 6.5 MBytes removable (5-and-5 MBytes, formatted), it has enough capacity to handle almost any application.

And, Micro-Magnum's access time is just 40 milliseconds.

The right kind of removability and security.

Unlike floppies, Micro-Magnum's cartridge matches the fixed disk capacity one for one. Unlike streaming tapes, the 5¼" cartridge provides random access.

Unlike *both* floppies and tapes, Micro-Magnum provides the same access time, the same data rates, the same zero maintenance schedule for both fixed and removable files.

Full disk-to-disk backup takes less than 90 seconds.

The right way to protect data.

Micro-Magnum features a unique retractable head that never touches the disk. Plus a self-sealing clean air system that prevents contaminants from reaching the data—even after thousands of cartridge insertions.

And Micro-Magnum features an embedded servo for reliable cartridge interchange and positioning accuracy.

Just the right size.

Micro-Magnum matches mini-floppy front panel dimensions. The space-saving fixed/removable concept uses only one front panel. And you can adapt existing 5¼" Winchester drive controllers.

We're shipping.

Others promise delivery. Our class 100 manufacturing facility is producing. We're delivering.

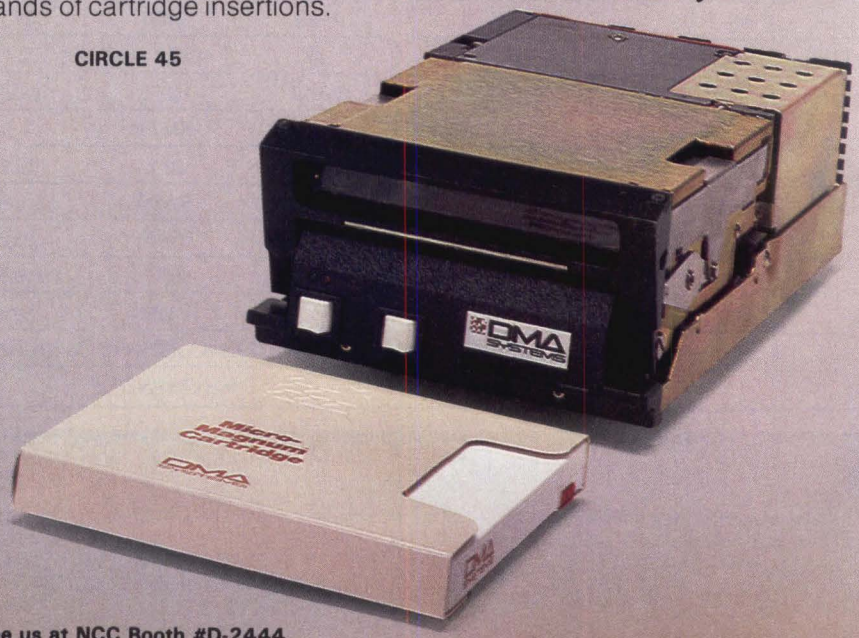
The Micro-Magnum fixed/removable disk drive: The true Winchester memory system... without any ifs, ands, or buts.

For more information write DMA Systems, 601 Pine Avenue, Goleta, CA 93117. Or call us at (805) 683-3811, Telex 658341.

DMA SYSTEMS

Just what the industry needs.

CIRCLE 45



See us at NCC Booth #D-2444

ncc '83 product preview

system elements

Photo ID/computer badge system

Producing indestructible photo ID badges that are computer compatible (for data collection, time and attendance, and door access control), the system requires less than 1 ft^2 (.09 m^2) of space and weighs only 20 lb (9 kg). Polyester badges are custom designed to specifications. Badges can have high or low energy magnetic stripe, bar code, OCR, Hollerith/computer punching, and embossing; with or without photo. ***Identatronics***, 425 Lively Blvd, Elk Grove Village, IL 60007. **See at Booth D2015** **Circle 217**

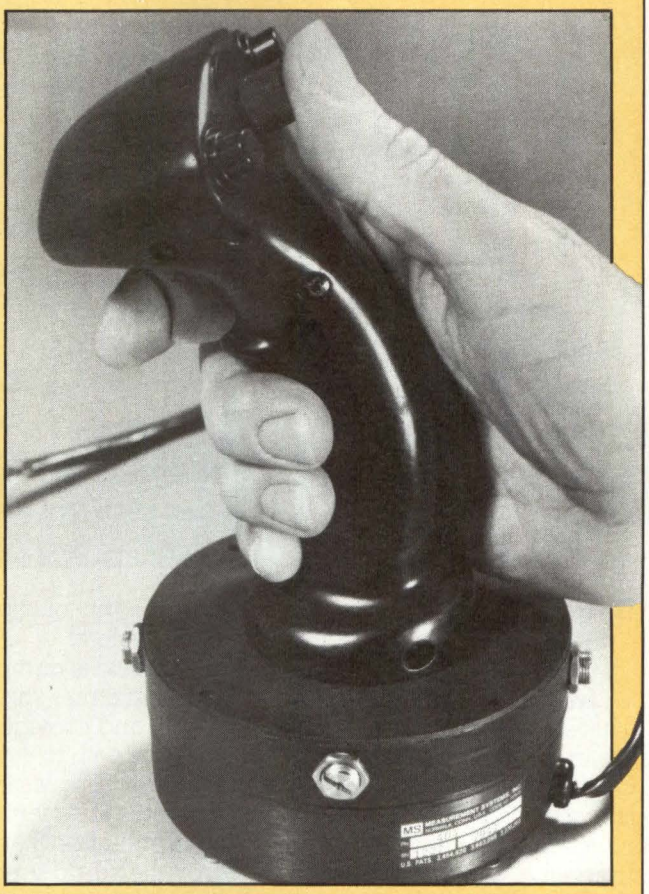
Ultraviolet EPROM erasing systems

C-25 and C-50 EPROM erasers feature timer to set exposure; safety interlock to prevent accidental ultraviolet exposure; long-life, high intensity ultraviolet grid lamps for minimum erase times; cooling fan to minimize heat buildup; conductive foam pad to eliminate charge buildup; and viewing port(s) to observe lamp operation. In both models, erase times at 6 W-s/cm^2 are 8 to 10 min; at 15 W-s/cm^2, 17 to 22 min; and at 25 W-s/cm^2, 28 to 37 min. Designed for 24-pin type EPROMs, C-25 capacity is 25 chips; 50 for the C-50. Both systems measure 9″ x 9″ x 4.75″ (23 x 23 x 12.07 cm), and use 100/115/215/250 V, 50/60 Hz. C-25 is specified at 170 W, and C-50 at 270 W.

Also shown will be the 4-W Memorase® DE-4 model, which erases eight 24/28-pin chips in 51 min (4 in 40 min), along with industrial model C-90, which erases up to 600 EPROMs in 7 min. ***UVP, Inc,*** 5100 Walnut Grove Ave, San Gabriel, CA 91778. **See at Booth N4509** **Circle 218**



Multi-axis hand controls



Force operated hand controls feature 4 primary axes that can be expanded to as many as 10 proportional outputs. With application in teleoperator or robot programming, the 404 series is available with a choice of 6 different hand grip configurations and with pure force in all axes or with force with limited motion in either 2 axes or all 4 axes. Also shown is the model 531, a 2-axis potentiometer type of joystick that features rugged all metal construction. Complete with environmental boot seal and high reliability conductive plastic center-tapped potentiometers, the unit provides direction or limit switches together with a finger operated switch on the joystick handle as options. ***Measurement Systems, Inc***, 121 Water St, Norwalk, CT 06854. **See at Booth P7107**
Circle 219

NOTE: "A" series booths are located in Anaheim Convention Center's Arena, "N" series in the North Hall, "S" series in the South Hall, and "W" series in the Southwest Hall. "P" series booths are in the NCC Pavilions adjacent to the Registration area. "D" series booths are located in the Disneyland Hotel Convention Center.

How To Avoid



Give FCC Docket 20780 the silent treatment with connectors from ITT Cannon.

There's a new code of silence in Washington. It's called FCC Docket 20780. And, beginning October 1, 1983, your system will have to meet its stringent EMI/RFI requirements. One company's connectors already do. The ones from ITT Cannon.

Our Shield of Integrity.

The Cannon® D Series of subminiature shielded/shrouded connectors help maintain the integrity of your entire shielded system.

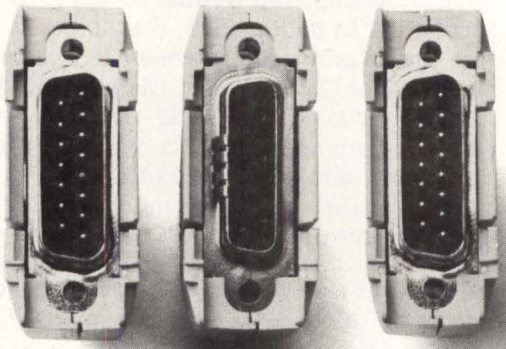
Our shield is crimped to the cable to maximize shielding capability and provide a low-impedance path to the ground.

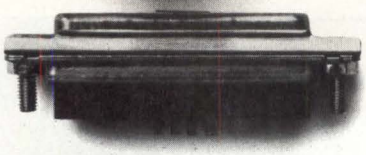
The shroud/plastic backshell isolates the user from ground potentials that may exist on the shield. And plastic strain-relief members are provided to prevent cable pull-out. The center-latched version is available in configurations of 9, 15, 25 and 37 contacts.

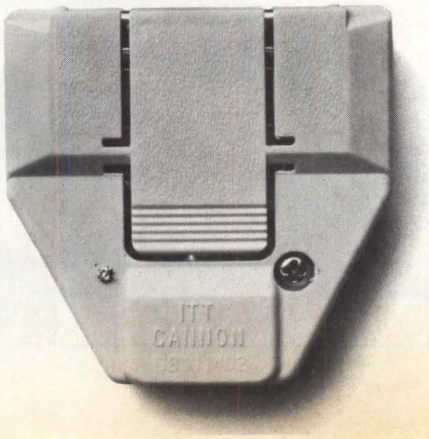
Systems should be seen. And not heard.

Cannon's D Subminiature Transverse Monolith connectors reduce EMI/RFI noise

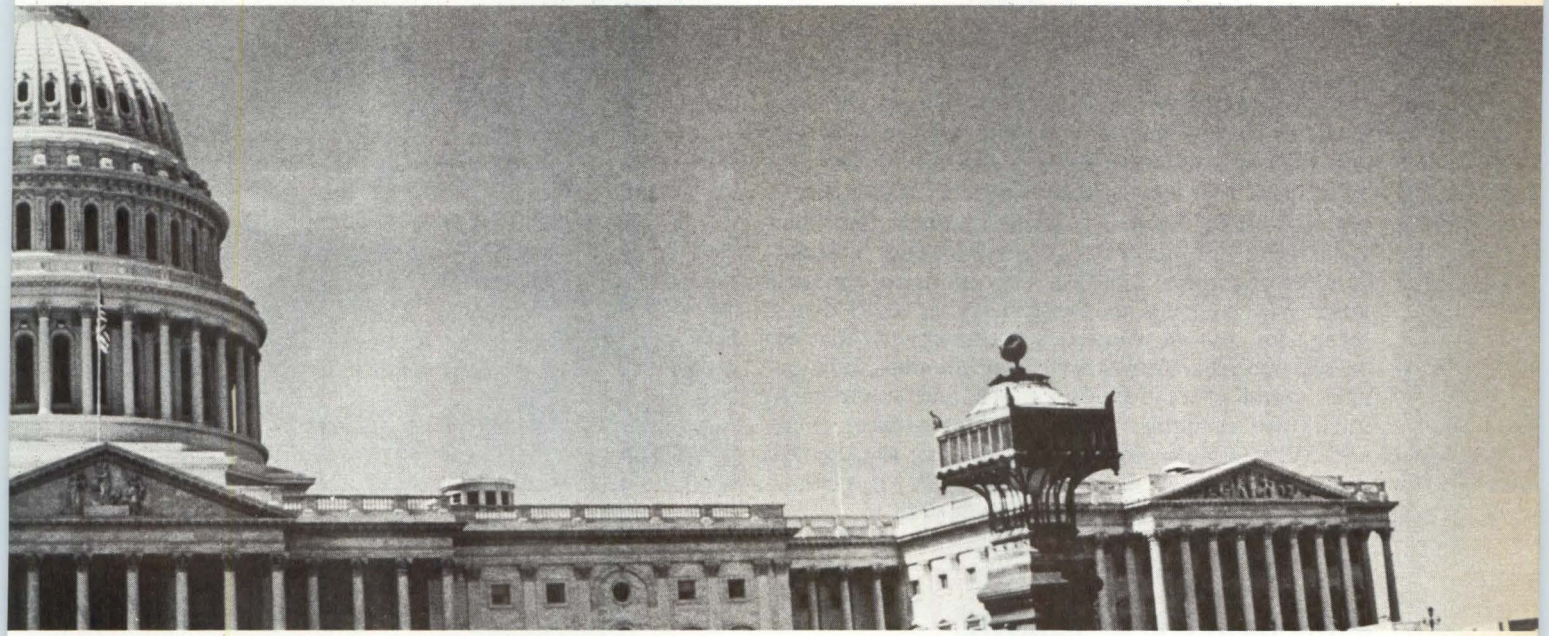
D Subminiature Shielded D Series



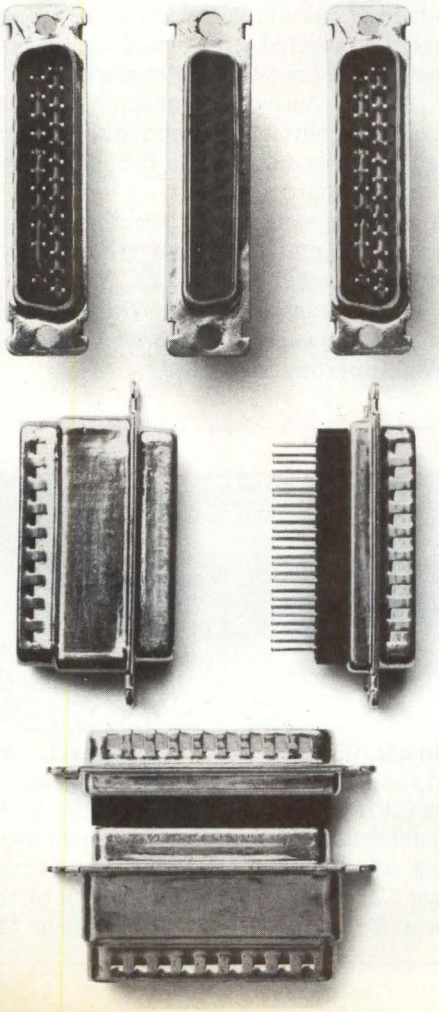




Capitol Punishment.



D Subminature Transverse Monolith Filter Connectors



to help meet Docket 20780 requirements.

The addition of the transverse monolith filter expands the technical versatility of the D Subminiature without adding to the overall dimensions of the connector. And these Cannon connectors are available in contact arrangements of 9, 15, 25 and 37, with a wide range of capacitances and cutoff frequencies offered.

Join the Silent Majority.

Write for ITT Cannon's free brochure, "Silent Solutions To Your EMI/RFI Problems." Because with a regulation like Docket 20780 on the books, it's hard to keep quiet.

For more information on Transverse Monolith Filter Connectors, contact Phoenix Division, ITT Cannon, 2801 Air Lane, Phoenix, AZ 85034. Telephone: (602) 275-4792.

Contact Commercial/Industrial Products for more information on the D Subminiature Shielded D Series. ITT Cannon, a Division of International Telephone and Telegraph Corporation, 10550 Talbert Avenue, Fountain Valley, CA 92708. Telephone: (714) 964-7400.

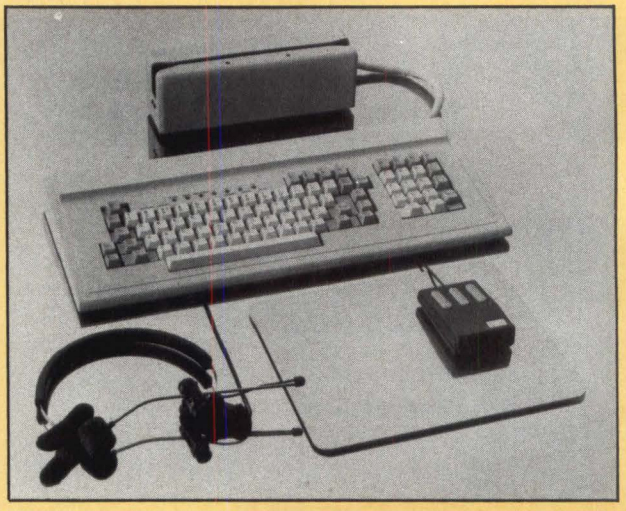
CANNON ITT

The Global Connection

CIRCLE 46

system elements

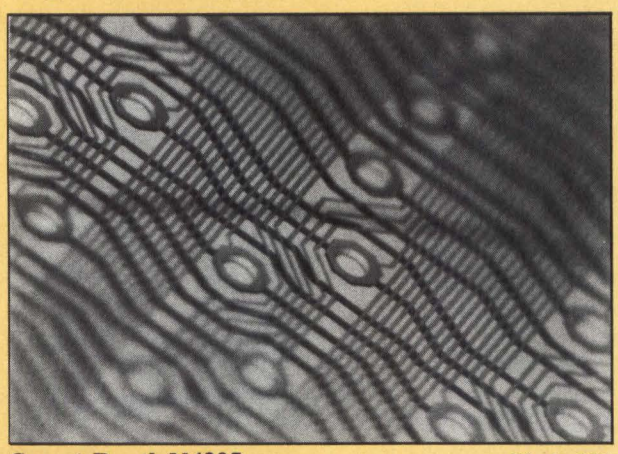
Data entry devices



Optical mouse, voice input, and optical character recognition (OCR) devices are integrated with keyboard system and serve as alternatives to it. The optical mouse is more reliable than its mechanical equivalent, and serves where full cursor mobility is required. The discrete phrase, speaker dependent voice input unit has a vocabulary size that is dependent on memory. The unit can adapt to anyone's voice via a training session. The OCR device recognizes printed characters on documents that are passed manually through a slot in the unit. It recognizes standard E13B (MICR), OCRA, and OCRB fonts; others are available. Electronics for mouse, voice, and OCR devices are integrated into low profile enclosed keyboards. ***Key Tronic Corp,*** PO Box 14687, Spokane, WA 99214. **See at Booth W6270**

Circle 220

High density PC boards



See at Booth N4305 **Circle 221**

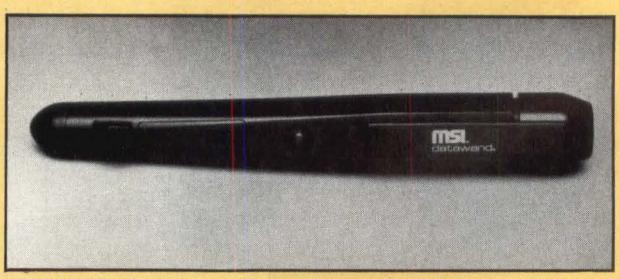
Metriform circuits are miniature 2-sided and multilayered PC boards with a variety of applications including nonimpact printheads and hybrid multilayered chip carriers. The boards are made in glass (3 to 10 mils thick) and other substrates such as ceramic. Conductive circuits are electroplated onto either surface and connected with plated thru holes. Typical conductive lines are arrayed in packing densities of up to 1000 lpi. Active electronic devices such as integrated circuit chips, LEDs, and photodiodes can be mounted on either surface and then connected to any circuit on the board.

Boards can also be sandwiched together into a multilayer package. Circuits on glass are attractive for making large addressable arrays of photoactive elements due to the transparency of the material. ***Metrigraphics Div, Dynamics Research Corp,*** 50 Concord St, Wilmington, MA 01887.

Remote bar code scanning wand

A data entry device that combines bar code scanning, memory, and rechargeable batteries, Datawand reads, decodes, stores, and transmits bar coded information independently of a data entry terminal.

Resembling a conventional scanning wand, the device measures 6.25″ (15.87 cm) long x 0.850″ (2.159 cm) in diameter. Small outline packaging (SOP) and vapor-phase soldering techniques are used to pack 4000 digits of low power CMOS memory for data storage, scanner firmware stored in an onboard microprocessor memory, and rechargeable NICd batteries into the unit. An LED indicator and a beep from an internal speaker signal scans, deletes and transmits.

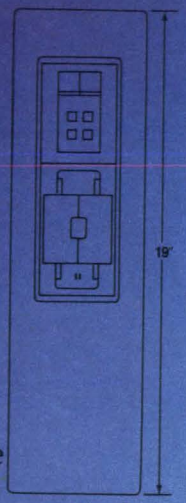


When not in use, the Datawand rests in a recharger module called the Datawell. This module also serves as an interface for transferring data over phone lines. Data are transferred to either an MSI handheld computer or a host computer via an RS-232-C type interface. ***MSI Data Corp,*** 340 Fischer Ave, Costa Mesa, CA 92626. **See at Booth S5615** **Circle 222**


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CIRCLE 47

Digital's new multi-user, multi-tasking Micro/PDP-11™ gives you all the microcomputer you need to solve your application problems. At a price almost anyone can afford—$9,200.*

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More software. Over 2,000 developed applications are available for laboratories, factories offices, and other businesses. And thousands of PDP-11 trained programmers ready to write even more.

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HL2-1/E10
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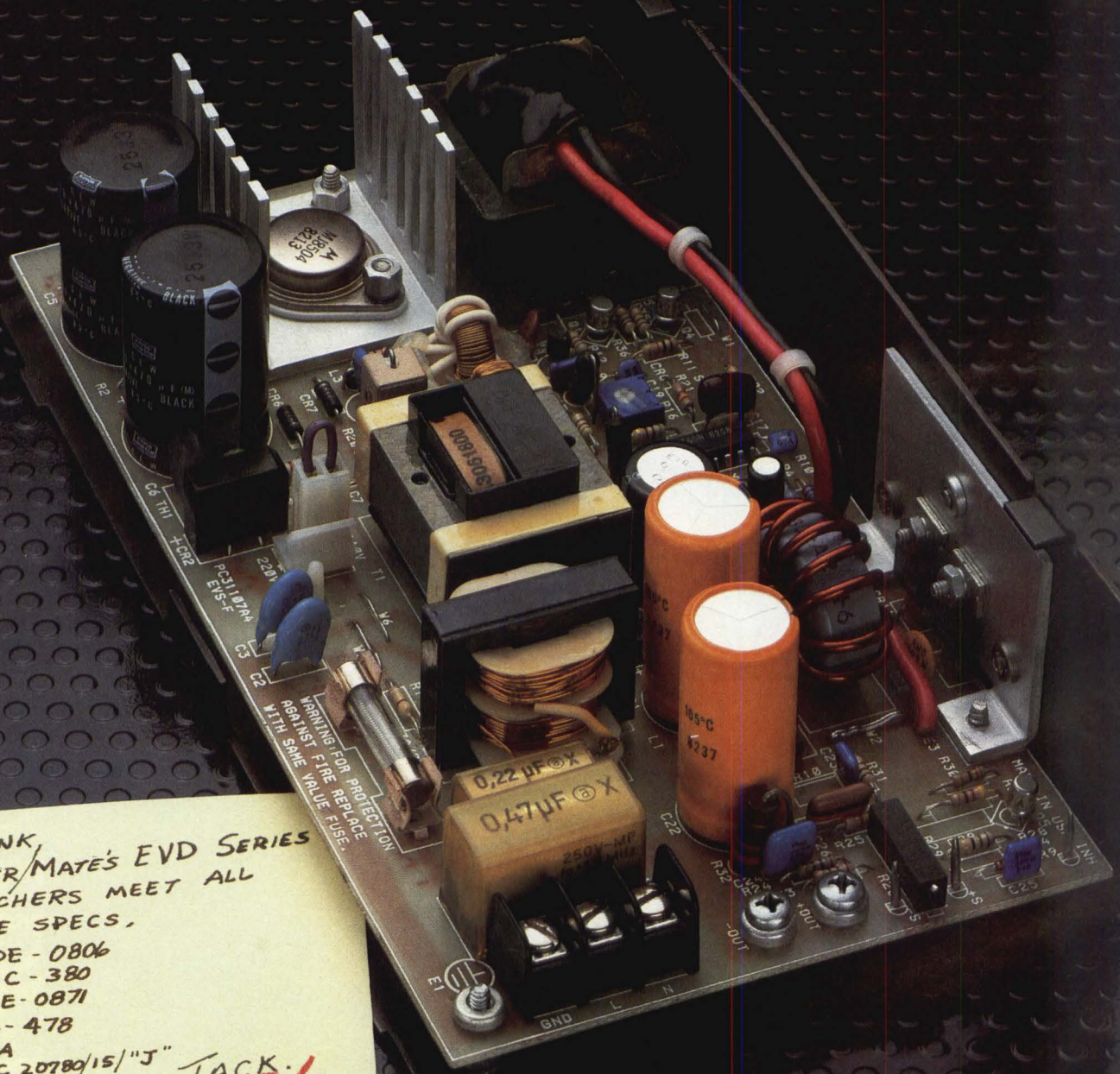
Actual size: 5¼" x 19"

digital

No other micro can stand up to the Micro/PDP-11.



The only one left to convince is you.



FRANK,
POWER/MATE'S EVD SERIES SWITCHERS MEET ALL THESE SPECS.

VDE - 0806
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GO WITH IT!
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CIRCLE 48

RTEPOWER/MATE

THE PACESETTER IN SWITCHING POWER SUPPLIES

POWER/MATE CO. 514 South River Street, Hackensack, NJ 07601-6697 • (201) 440-3100 TWX: 710-990-5023

system elements

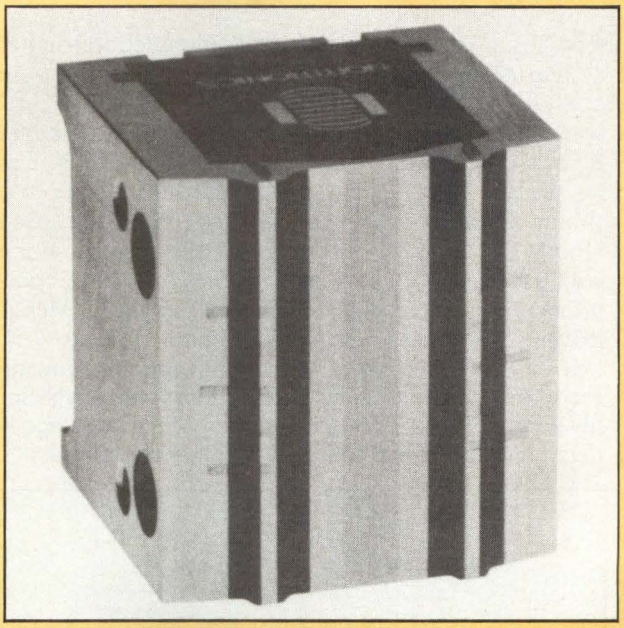
DIN compatible keyboard

Low profile, solid state keyboard measures less than 18 mm from top of PCB to the required center of the home row keycaps. The DIN spec calls for a maximum height of 30 mm, measured from the top of the desk to the top of the home row keys when the keyboard is mounted in its enclosure. Key modules include keycap, snap-in housing, plunger, spring, and metallized Mylar pad. Designed as a capacitive plate, the pad is positioned over a second set of capacitive plates on the PCB. Capacitance changes with key travel since the pad is angled, resulting in key hysteresis. This aids in eliminating teasing.



A sense amplifier detects changes in capacitance. It incorporates an ANY-KEY-DOWN output that is monitored when other keyboard electronics are applying a pulse drive. Linear or pad tactile feel is available with a positive stop. Full 0.15″ (3.81-mm) nom travel is standard. Operating force is 2 oz; 2½ oz is an option. Sculptured and/or stepped spherical keycaps are also available. ***Cherry Electrical Products Corp,*** 3600 Sunset Ave, Waukegan, IL 60087. **See at Booth P7035** **Circle 223**

Serpentine streamer head

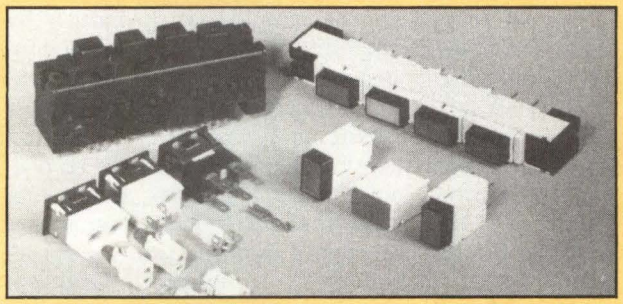


A 9-track, 2-channel serpentine streamer head stores 45M bytes on ¼″ magnetic tape cartridge for Winchester backup. The head contour is designed to operate at tape speeds of 30 to 90 ips. This allows reliable recording at 10,000 fcpi. The internal design of the head provides for suppression of write-to-read feedthrough voltage of 4% maximum. A 2% maximum model is available. Life Time Ceramic® coating extends wear life and eliminates the need for tape gutters. Options include piggyback erase, mounting hardware, and cable or connector termination. ***Nortronics Co, Inc,*** 8101 Tenth Ave N, Minneapolis, MN 55427. **See at Booth N4111** **Circle 224**

Miniature solid state switches

Miniature Manual line push buttons and indicators have been expanded to include solid state Hall effect units that interface directly with microprocessors and other logic devices. The line includes incandescent as well as full face LED illumination, mechanical interlock mechanisms, add-on bezels for snap-in front-of-panel mounting, strip mounting options, alternative termination, and relamping capability for printed wiring boards.

Designed for maximum flexibility in a minimum of panel space, switch housings are 0.67″ (17 mm) deep and feature single-level termination. The miniature switches need a 5-Vdc supply voltage. They have a momentary or 2-level alternate action and come with legendable lenses designed to comply with UL and CSA requirements.

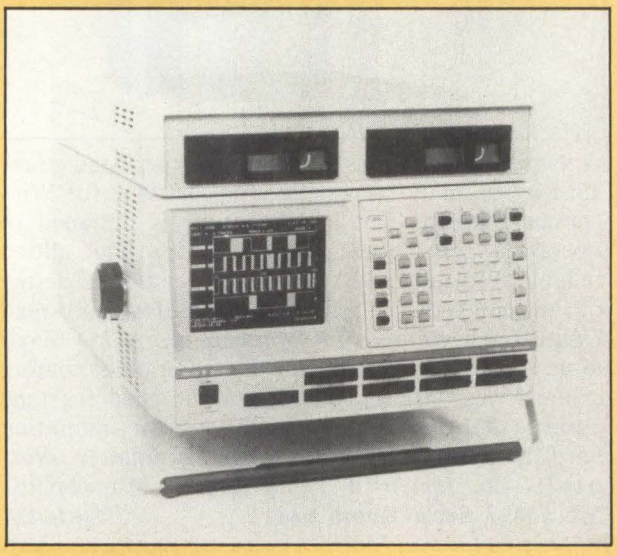


Design options include red, yellow, and green lenses, 3 electrical ratings, and several circuitry/operating combinations (including multiswitch interlock). Switch and indicator lenses are furnished as separate items. Op temp for the series is 32 to 149 °F (0 to 65 °C). ***Micro Switch, A Honeywell Div,*** 11 W Spring St, Freeport, IL 61032.
See at Booth N4204 **Circle 225**

test & measurement

Modular logic analyzer

K105-D is a 72-input logic analyzer intended for digital system design and development, including software analysis, hardware analysis, and hardware and software integration. Slots in the chassis accommodate boards to expand or reconfigure capabilities. It can be set up with 32 or 64 main (20-MHz) state and timing sample inputs and 8 or 16 high speed (100-MHz) state and timing sample inputs, along with RS-232 general purpose interface bus (GPIB) communication capability, and disk storage. Menu-driven screens enable users to set up the unit easily. A help key provides interactive aid to users by allowing them to call up a detailed minimanual from any point in the operation. The trace control setup language is derived from Pascal and uses English commands.



System activity can be sampled synchronously by using 8 external clock inputs that can be combined into 4 Boolean expressions. Eight levels of trace control, using up to 32 different word patterns, allow precise definition of the analysis path and selection of specific segments of system operation for recording and review. Noise margin analysis, parametric reference testing, 1024-word recording memory, and automatic reference memory comparison modes let users verify the design's operation. Optional disassemblers for the 68000, 8086, 8088, Z80, 8085, and 8080 microprocessors allow users to monitor microprocessor operation in assembly language mnemonics rather than object code. Main and high speed inputs are linked to aid software integration productivity. ***Gould Inc, Design and Test Systems Div,*** 4600 Old Ironsides Dr, Santa Clara, CA 95050. **See at Booth W6058** **Circle 226**

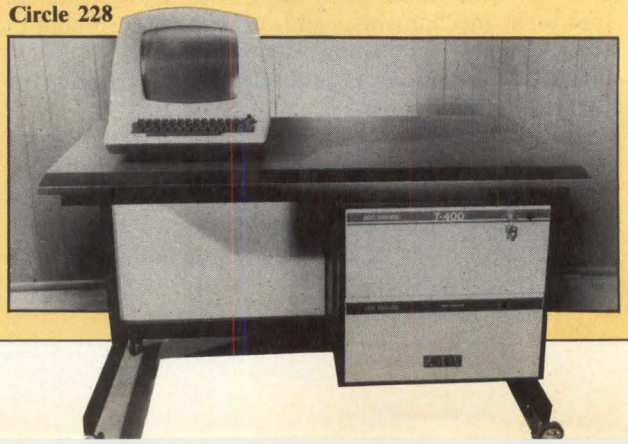
Computer tape cleaner/tester

MLT-502 cleans, retensions, removes static charge, and evaluates the condition of 800-, 1600-, or 6250-bpi tapes in 4.25 min. The system counts and charts 1-, 2-, and 3- track dropouts computer correlated at low, nominal, and critical levels so that users can classify tapes safe for critical runs. Tapes that should be stripped or discarded are also classified.

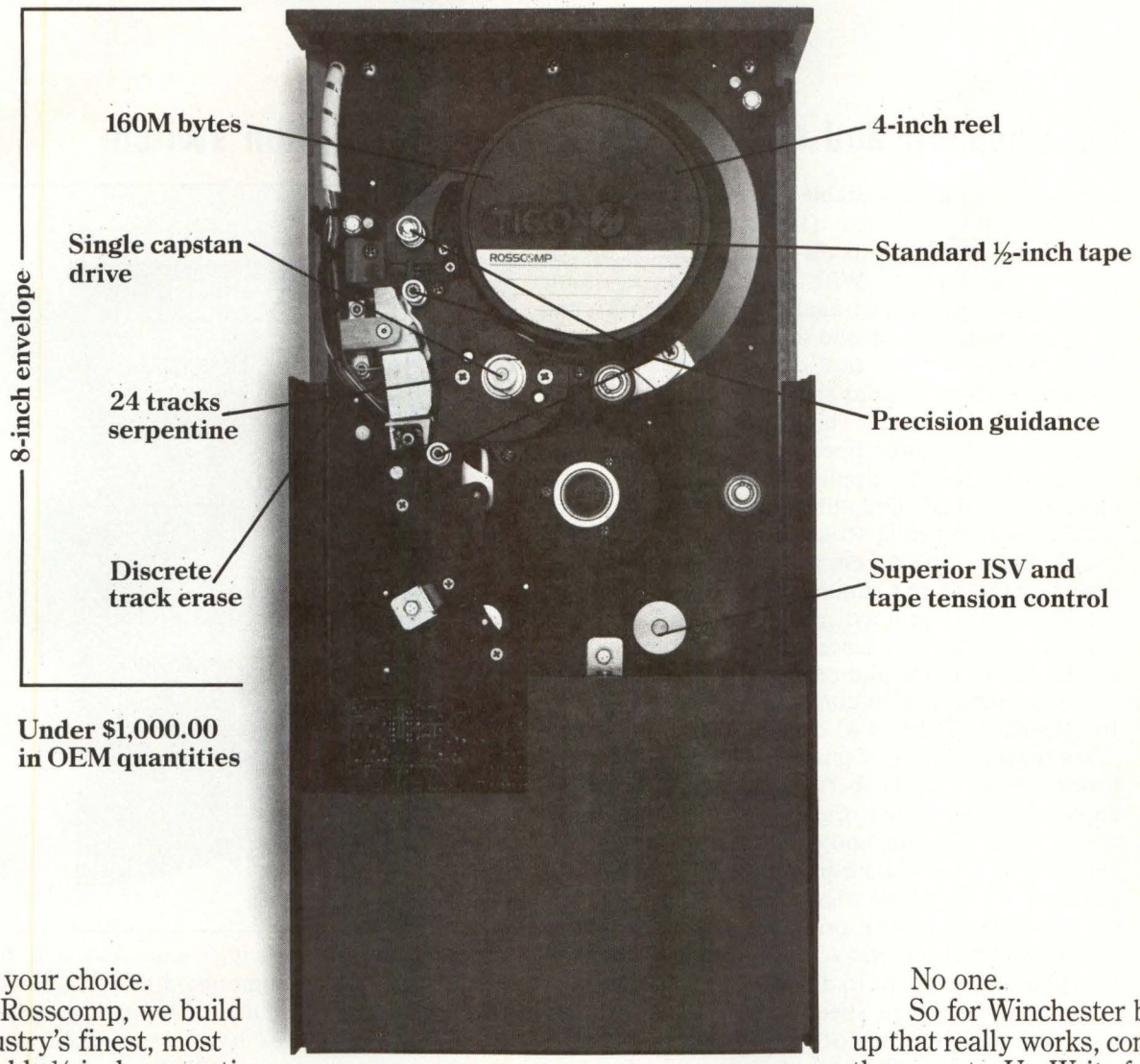
Although the device employs the same cleaning and testing techniques as higher priced systems, throughput speed and automatic tapeloading are sacrificed. Disk duplication services for OEMs and software houses, flexible disk packaging configurations, a series of rigid antistatic mailers, and a line of data cassettes will also be shown. ***Dennison KYBE Corp,*** 82 Calvary St, Waltham, MA 02254. **See at Booth N4100** **Circle 227**

Disk drive margin tester

Time Interval Analyzer TIA-100A is a general purpose time domain analyzer for use in design, test, and troubleshooting of floppy disk and magnetic tape drives. Designed to accept encoded logic level reproduce data, the tester uses a time interval measurement technique and CRT display format to permit accurate, near realtime evaluation of jitter, bit shift, margin, and error rate. Margin effects of azimuth and radial misalignment, overwrite modulation, write current level, and other parameters are evaluated. Display format provides interactive control of test parameters and realtime assessment of bit shift test results, eliminating waits for completion of canned test routines or manual plotting of histogram data. Bit shift events are captured at frequency of occurrence rates as low as 1 in 10^9 to a time resolution of 10 ns. Bit shift or margin are measured directly in units of time for all possible encoded intervals. Criteria of acceptance are expressed in numerical terms. ***Applied Data Communications,*** 14272 Chambers Rd, Tustin, CA 92680. **See at Booth P7006**
Circle 228



Use it.



It's your choice.

At Rosscomp, we build the industry's finest, most dependable ½-inch magnetic tape drives to back up high-capacity Winchesters. Our D160 records 160M bytes on 24 tracks in less than 20 minutes, uses standard ½-inch tape, and fits into an 8-inch envelope. No one else can say that.

No one.

So for Winchester back up that really works, come to the experts. Us. Write for details on our Evaluator Package, and see for yourself how well we back you up.

Think about it. You've come a long way in storage capacity.

And that means you've got a lot more to lose.

Or lose it.

ROSSCOMP

We're backing up your future.

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CIRCLE 49

See us at NCC, Booths D2427, D2429, D2431, D2433

ncc '83 product preview

data communications

Development and test system

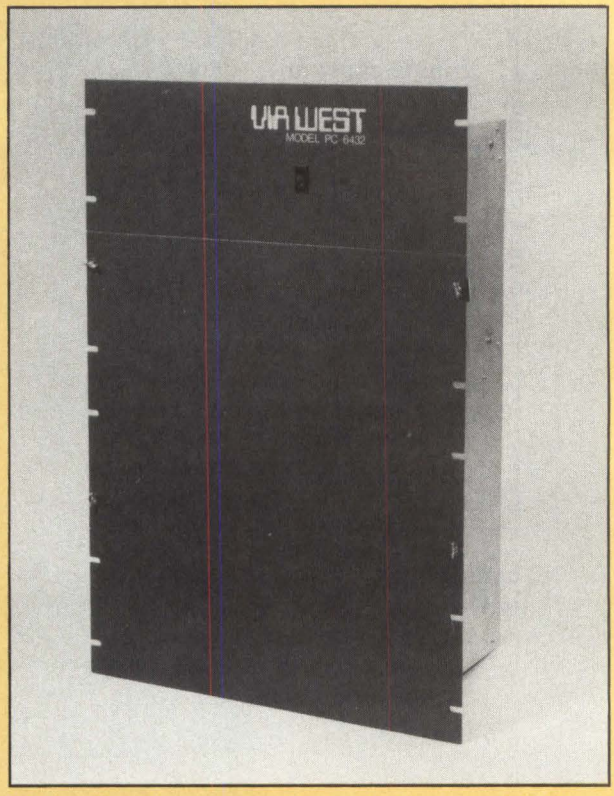
Chameleon is an adaptable development tool for X.25, SNA/SDLC, ADCCP (HDLC, SDLC, extended mode), and Bisync protocols using ASCII, EBCDIC, or hexadecimal format. With 700k bytes of online storage, the system will analyze traffic density and response times, develop and support hybrid protocols, and simulate DTE or DCE devices in bit- or byte-oriented environments at speeds to 128k bps. Multiprocessor architecture, high level programmable couplers, and flexible operator interface adapt the system to specific applications. One processor handles physical and link levels, and can be programmed to handle HDLC, SDLC, Bisync, or Transparent Bisync link access protocols. A second processor supports 1 of 4 simulation packages responsible for higher level protocol procedures and data generation. A simulator trace function simultaneously displays transmitted and received data.

The portable system comes in a 17.25″ x 8.75″ x 16″ (43.82- x 22.23- x 41-cm) case with integral 9″ (23-cm) green screen displaying an 80-col x 24-line format. Weight is 35 lb (16 kg). Split screen, full-duplex time-correlated display with full/half intensity, inverse, blinking, and underlined video supports analysis functions. Menu-prompted analysis setup is equipped with multiple triggers, timers, and counters to help isolate network problems and gather statistics. Triggers can be used to select data for capture in the 16k-byte buffer, or to direct data to disk for later evaluation. Two high speed 3½″ Sony disk drives provide 350k bytes each of formatted program/data storage, with a 500k-bps maximum transfer rate. ***Tekelec Inc,*** 2932 Wilshire Blvd, Santa Monica, CA 90403.



See at Booth N4910 **Circle 229**

Port contention switch



Through microsequencing techniques and bidirectional switch, cabinet-mounted PC-6432 allows up to 64 terminals to contend for 32 computer ports on a first-come, first-served basis. Multiplexer operation is user transparent to 19.2k bps, synchronous or asynchronous. A universal I/O card adds 4 terminals or computer ports to provide for expanded configurations; LEDs indicate ports available or in use. ***Via West, Inc,*** 534 N Stone Ave, Tucson, AZ 85705. **See at Booth D1704** **Circle 230**

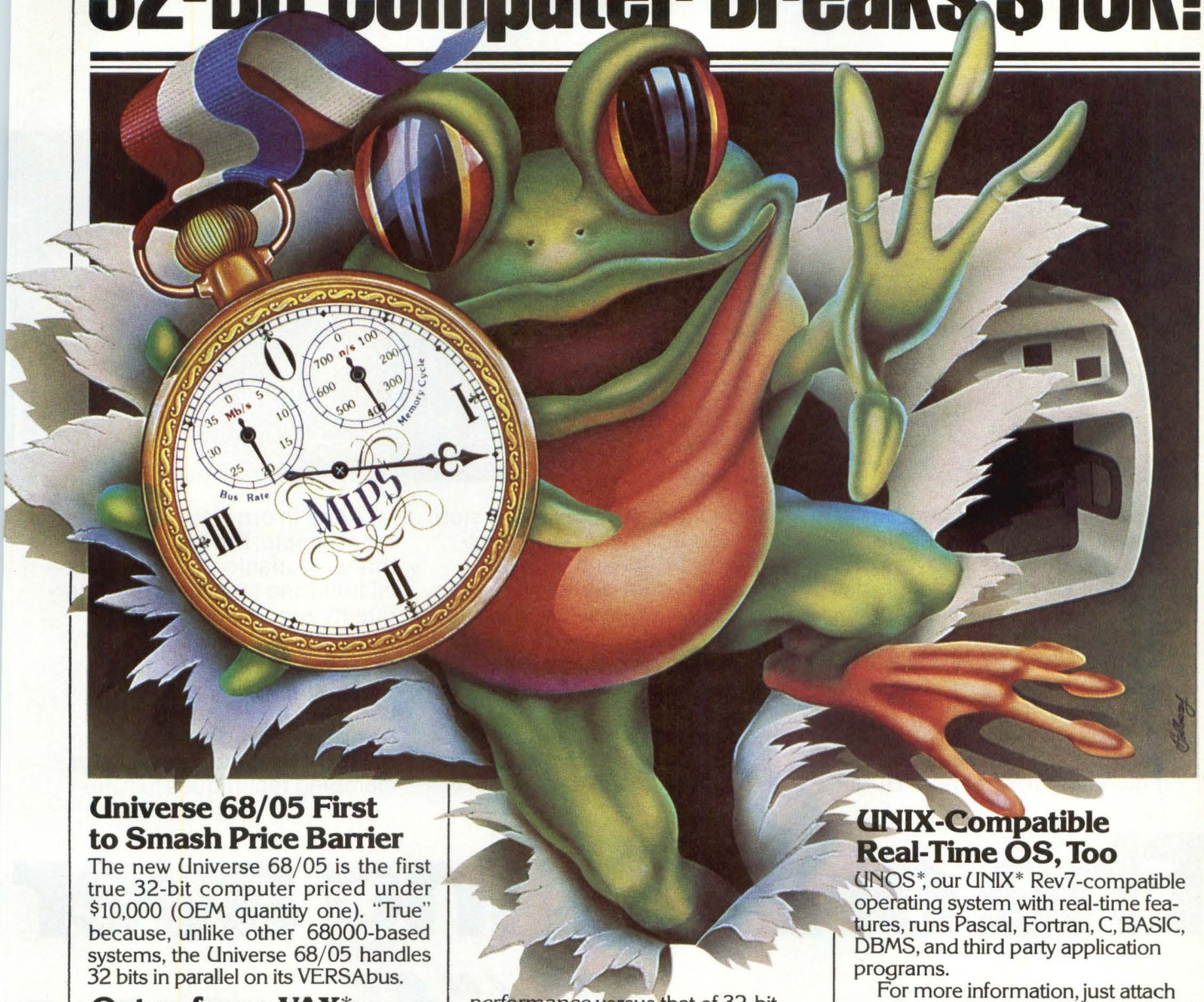
1200-bps single-board modem

Smartmodem 1200B, a 300- to 1200-bps Bell 103/212A modem for the IBM PC, is bundled with Smartcom II, a communication program. The software allows users to transfer data to other microcomputers, mainframes, or remote terminals, and to access up to 26 information services or private networks. ***Hayes Microcomputer Products Inc,*** 5835 Peachtree Corners E, Norcross, GA 30092.

See at Booth D1550 **Circle 231**

★ ★ ★ EXTRA ★ ★ ★

32-Bit Computer Breaks $10K!

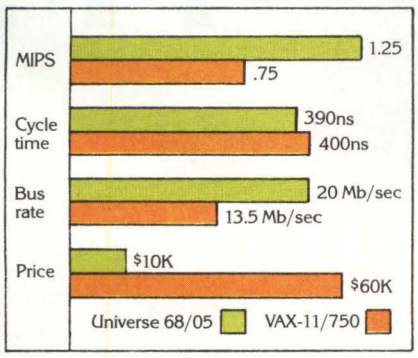


Universe 68/05 First to Smash Price Barrier

The new Universe 68/05 is the first true 32-bit computer priced under $10,000 (OEM quantity one). "True" because, unlike other 68000-based systems, the Universe 68/05 handles 32 bits in parallel on its VERSAbus.

Outperforms VAX*

Its *price* is even more impressive when you look at Universe 68/05 *performance* versus that of 32-bit "superminis" several times more expensive, like the VAX-11/750.



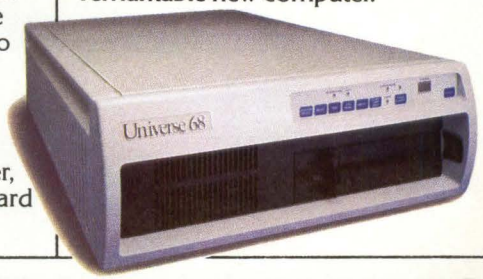
High-Speed 68000, 4Kb Cache, 32-Bit Bus

The key to that performance is a 4Kb cache that eliminates processor wait-states and takes full advantage of a 12.5MHz 68000 processor. Also included are a separate 68000 I/O processor, four serial I/O ports (expandable to 64), 256Kb RAM (expandable to 3Mb), 20Mb/sec, 32-bit VERSAbus, 10Mb Winchester, 1.25Mb floppy disk, and 5-slot card cage. All in a 7-inch enclosure.

UNIX-Compatible Real-Time OS, Too

UNOS*, our UNIX* Rev7-compatible operating system with real-time features, runs Pascal, Fortran, C, BASIC, DBMS, and third party application programs.

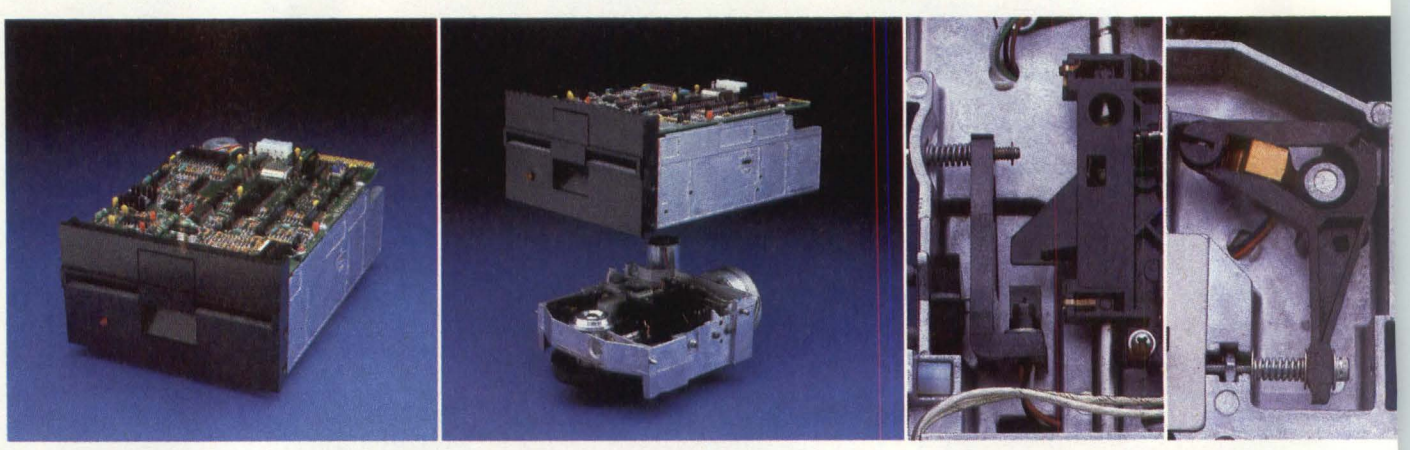
For more information, just attach your business card to this ad and mail to Charles River Data Systems, 4 Tech Circle, Natick, MA 01760. Or call us at (617) 655-1800. We'll send you a copy of "The Insider's Guide to the Universe," a detailed discussion of the technical concepts behind this remarkable new computer.



CHARLES RIVER DATA SYSTEMS

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CIRCLE 50



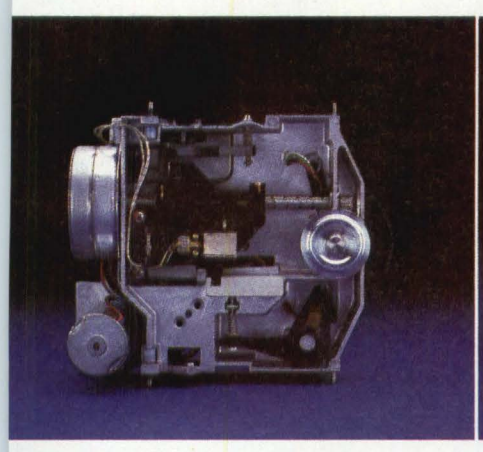
When we designed our new 1100 Series 5¼" 96 TPI floppy with up to 2Mbytes of storage, we set our standards high. High in reliability and high in performance. Naturally, we made it fully compatible with the industry—the same size, power, interface and bezel. It's even priced to compete with floppies that can't begin to match its performance. But that's where the similarities stop.

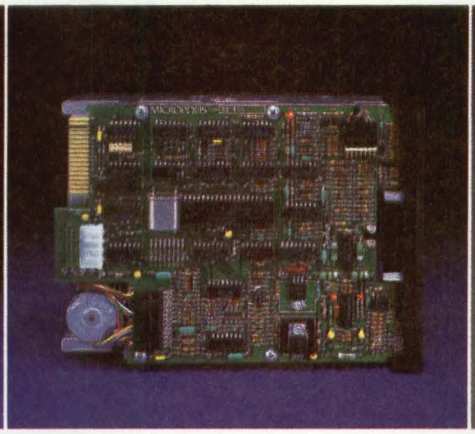
To begin with, we developed the 1100 with a unique chassis-within-a-chassis design to provide unequaled alignment stability—assuring that the positioning mechanics are isolated from mounting and system handling stresses. At the same time, it provides unmatched electrical shielding and acoustic noise reduction.

And in order to make alignment simple, the 1100 has only three mechanical adjustments—all featuring stable, micrometer-quality precision. All easily accessible while operating the drive with the PCBA in place.

Then, we included our temperature compensating positioner-to-spindle referencing and precision diskette clamping techniques for pre-

The only thing aver 5¼" floppy







cise track positioning—every time. With our 1100 series, diskette interchangeability is guaranteed.

And if that weren't enough, we designed out all electrical adjustments—making board replacement a breeze. The microprocessor electronics precisely control the spindle motor at the spindle, eliminating speed drifts and wear factors typically handled by pot settings. Nobody else can compete with that.

And because we've been building high performance floppies since 1977, nobody can mass produce them like we can. Nobody.

So if you want a high performance floppy for the same price you're now paying for low performance, give us a call.

At Micropolis, we don't believe you should have to pay more for the best.

Drop by and see us at NCC in Anaheim, booth #P7436.

Corporate Offices
21123 Nordhoff Street, Chatsworth,
CA 91311 • (213) 709-3300 • Telex: 651486

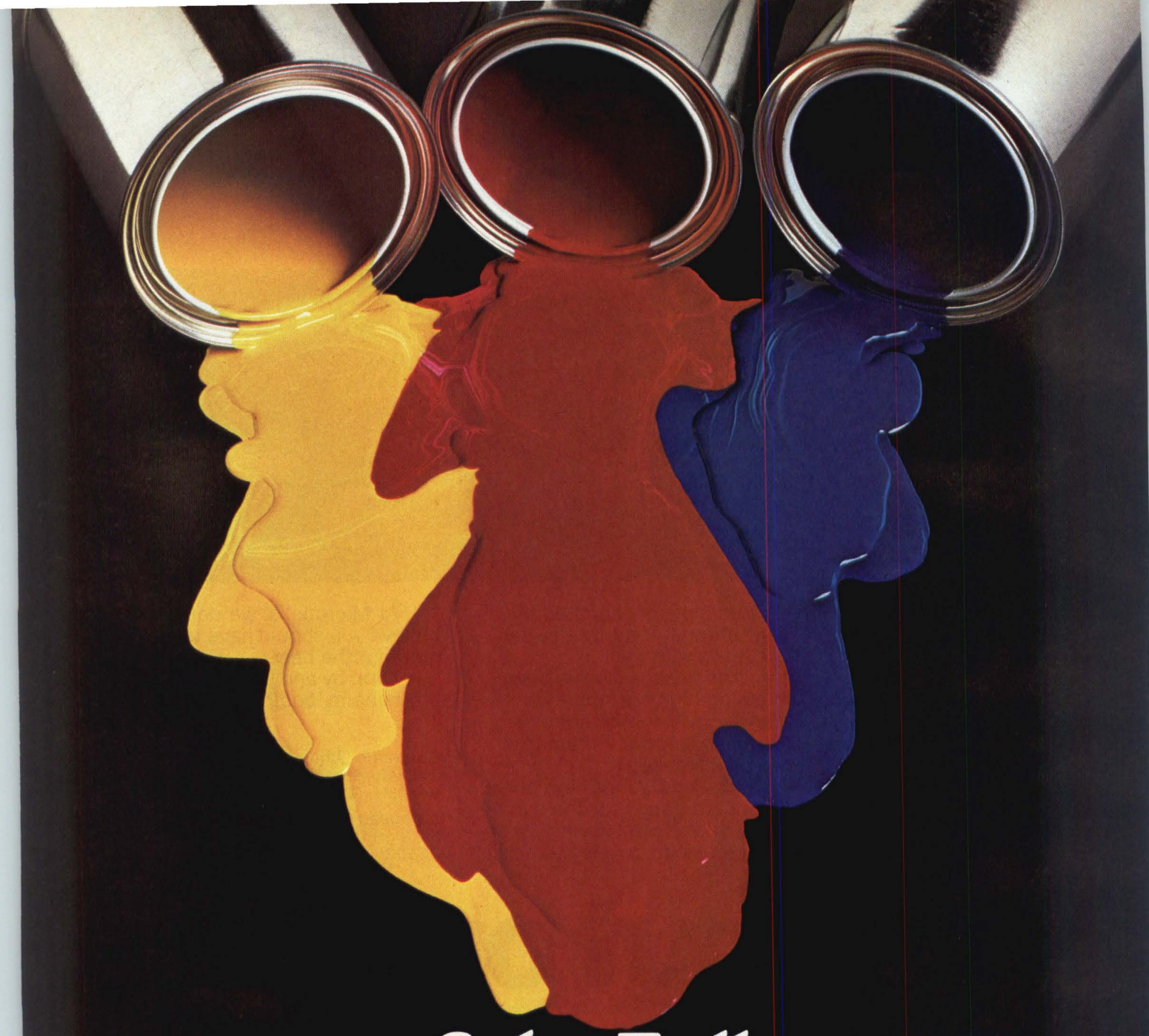
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age about our new is its price.

MICROPOLIS™

Where lasting memories are made.

CIRCLE 51

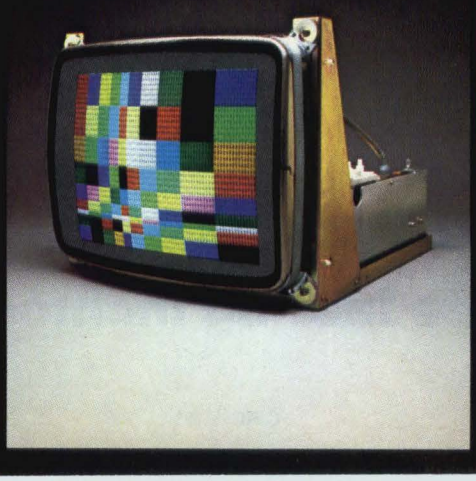


Color Full.

C. Itoh's ICM-14 color monitor adds a whole new dimension to data presentation. It combines precision display, quality workmanship and low price.

With ICM-14, complex information, images and tabulations suddenly become easier to understand, easier to read. Its 0.31mm shadow-mask dot pitch, 50-Hz to25-MHz bandwidth and 25-KHz horizontal deflection frequency deliver the high resolutions you need for your most demanding applications.

The ICM-14 accommodates up to 2,720 characters—all on a 13-inch diagonal screen. The design also includes a self-converging, in-line black matrix CRT to reduce both the circuitry and time required for convergence alignment. For added versatility, a built-in 115/230 VAC power supply is standard and the monitor adapts easily to 100 VAC power. Plus, C. Itoh's color monitor uses just 55 watts of power and is easily integrated into a wide variety of equipment configurations.



So get the color and precision you've always wanted. Contact C. Itoh Electronics, Inc., 5301 Beethoven Street., Los Angeles, CA 90066; (213) 306-6700. New York Office: 666 Third Ave., New York, NY 10017; (212) 682-0420. Chicago Office: 240 Lake Street, Addison, IL 60101; (312) 941-1310.

C. ITOH ELECTRONICS, INC.

One World of Quality

SEE US AT NCC-BOOTH #S5362

CIRCLE 52

ncc '83 product preview

data communications

Bisync communication interface



See at Booth P7960

Standard firmware in the bisynchronous communicator provides 2-way parallel and/or serial to asynchronous communications with user selectable data rates to 9600 baud. It handles a variety of protocols, including 2770, 2780, 3780, 3741, and 3270, as well as ASCII, EBCDIC, and Baudot codes. The Z80 based machine has 16K bytes of RAM buffer and 8K bytes of EPROM program area. Front panel mode switch and status LEDs simplify installation and help to identify operating problems. ***Xitron Inc,*** 814 Phoenix Dr, Ann Arbor, MI 48104.

Circle 232

High speed statistical multiplexer

M-860 handles transmission speeds to 76.8k bps in SDLC/HDLC bit-synchronous mode. Speeds for up to 32 asynchronous, full-duplex channels are individually selectable from 50 to 9600 bps. Thus, a 32-channel system can have a 307.2k-bps aggregate data rate. The system can be used with microwave and fiber optic links, as well as AT&T's 56k-bps Digital Data System.

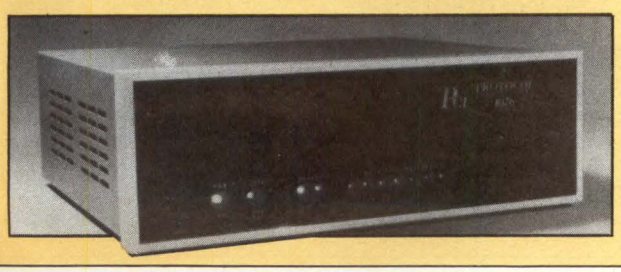
In interactive environments, the unit provides multiplexing efficiencies to 800%. Inband data flow is protected at each channel by a user programmable X-ON/X-OFF function, and out-of-band by CTS/DTR. Optional dual links provide for full transmission line backup. Standard features include CRC error detection and automatic retransmission upon line hits. The unit is fully programmable on a port by port or system basis and can be configured at either end. An interactive menu prompts operators through channel setup, statistics, and diagnostics.



M-860 is fully compatible with the company's DCS-2 system. Interface is via RS-232-C or CCITT V.24/V.28. Unit comes in 8-, 16-, 24-, or 32-channel configuration. Single or dual link and single or dual integral modems are also available; models with integral modem can support public and private lines. ***Teltone Corp,*** 10801 120th Ave NE, PO Box 657, Kirkland, WA 98033. **See at Booth P7706**

Circle 233

SNA/SDLC protocol converter

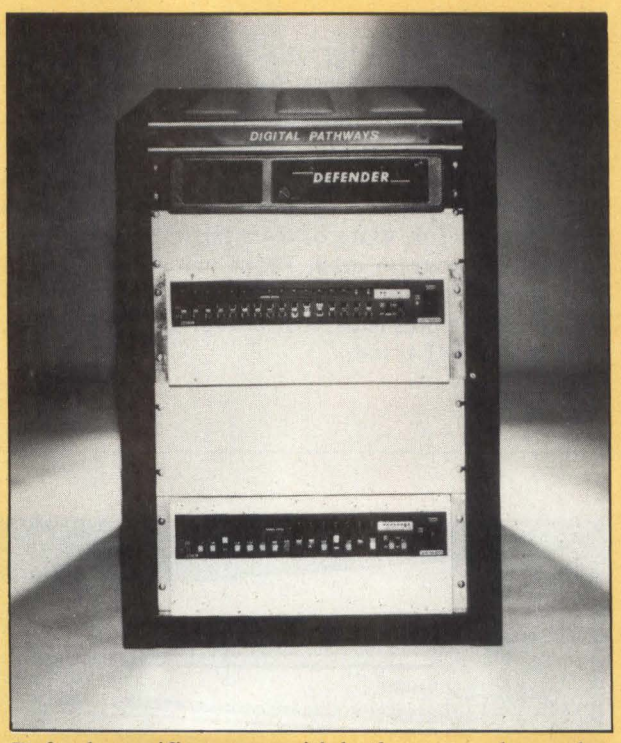


PCI 1076, an ASCII to 3270 SNA/SDLC protocol converter, lets personal computers, portables, microcomputers, and other devices including CRTs and printers communicate on a mainframe network. It connects to the host directly or by dial-up, allowing access to the host from virtually any location with a telephone. Up to 7 terminals can attach to one converter. ***Protocol Computers, Inc***, 6150 Canoga Ave, Suite 100, Woodland Hills, CA 91367. **See at Booth D2008**

Circle 234

data communications

Access security system



Defender verifies a user with both an ID code number and a physical location. After the system is called on any standard touchtone telephone, a digitized voice response asks for an ID code number. Once a number's validity is checked, the caller is instructed to either hang up or reenter the ID number. If the number is not successfully reentered in 3 attempts or 30 s, the system automatically disconnects and sends an alarm message to its printer.

Following a successful ID transaction, the unit tells the user to hang up, and then determines the user's speed class and priority. The user's authorized telephone number is retrieved from the system's memory, and its automatic dialer (a Racal-Vadic advanced Multiline Automatic Calling System) calls the user back. Phone line control is then transferred to the system's central modem. Even if the confidentiality of the ID number is compromised, an unauthorized user must be physically located at the authorized user's telephone.

Calls are handled on an outgoing basis. Computer use and telephone charges are closely monitored. Each transaction is dated and time stamped. A printer supplies hardcopy output. Capable of simultaneously addressing up to 59 users at speeds up to 9600 bps, the system is configured for 14 outgoing lines. ***Digital Pathways,*** 1060 E Meadow Cir, Palo Alto, CA 94303. **See at Booth P7714** **Circle 235**

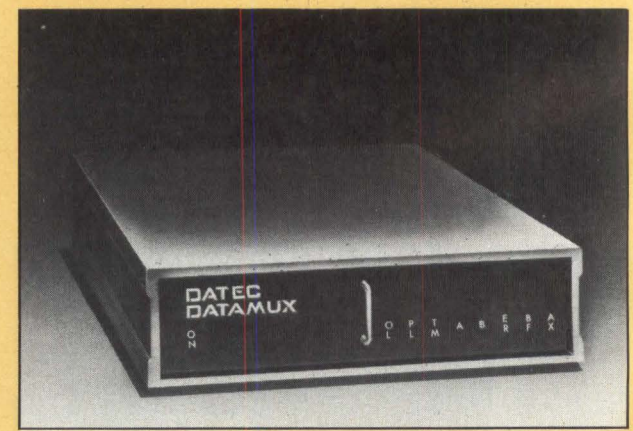
Limited area network

A proprietary design that uses coaxial cabling and a bus (not a star) network for use with the MAX-80 microcomputer, this LAN system features both high feed access and low cost per station—with up to 255 stations. The network allows each user station to share resources (line printers, hard disks, plotters) and to interchange electronic mail. Each station can retain individual floppy drives and printers. Also to be shown are disk drives based on Shugart 5¼" and 8" half-height floppy and hard drives, and Digital Research's CP/M 3.0, which provides full band switching, password protection of files, time and date stamping, and a health utility. ***Lobo Systems,*** 358 S Fairview, Goleta, CA 93117. **See at Booth P7030** **Circle 236**

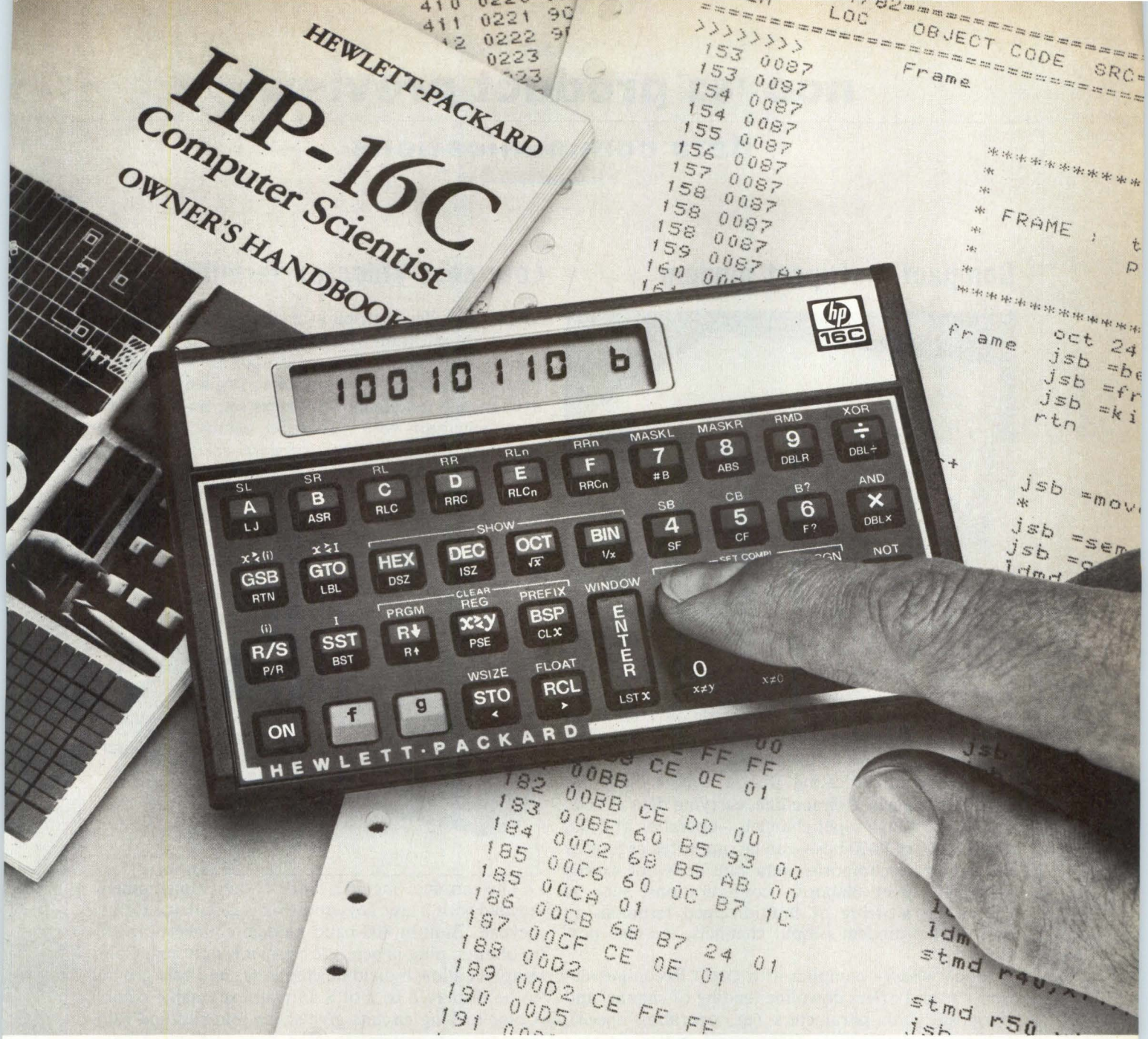
2-port statistical multiplexer

Port and composite link data rates up to 9600 bps are supported by the Datamux 2-port statistical multiplexer. The link protocol (SDLC) provides CRC 16 error detection and correction, preventing data errors from reaching either the user terminal or the host equipment.

Specifically designed to operate with the company's 212 modem and automatic calling unit, the multiplexer's features include automatic speed detection, complete diagnostics, and system statistics. Operating parameters may be selected from the terminal/computer equipment or via an internal option switch. The multiplexer is compatible with other synchronous modems. An ASCII-transparent mode allows users to communicate with the automatic calling unit through the multiplexer. ***Datec Inc,*** 200 Eastowne Dr, Suite 116, Chapel Hill, NC 27514. **See at Booth D1813**



Circle 237



It's got all the bases covered.

HP-16C. YOUR PRODUCTIVITY'S UP. AND THE PRICE IS DOWN. Now software engineers and logic designers can spend less time on bit-manipulation, Boolean and base-conversion functions and more time on more productive tasks. Like expanding your own creative potential.

How? Easy.

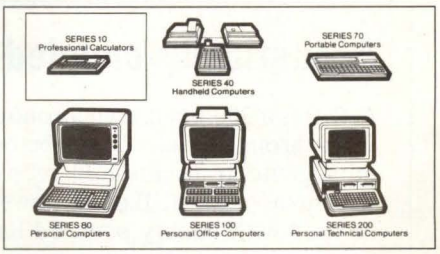
The HP-16C programmable calculator is capable of converting across four number bases, not only hexadecimal, octal, and decimal but binary as well. And it has the most powerful combination of bit manipulation, word size, and programming capabilities of any pocket calculator in the marketplace to date.

For the authorized HP dealer or HP sales office nearest you, call TOLL-FREE 800-547-3400 and ask for operator 72 (Oregon, Alaska, Hawaii: 503-758-1010).

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CIRCLE 53

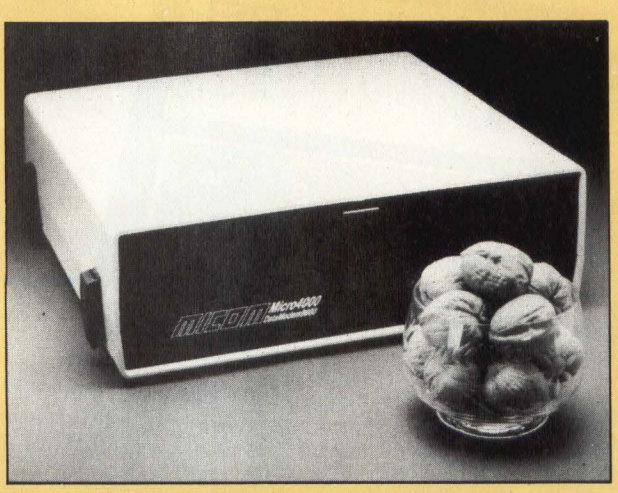
Personal computation products for professionals on the move.



HEWLETT PACKARD

data communications

Compact multiport modem



A time divison multiplexer is combined with a small 9600-bps modem in a single package to support up to 4 synchronous terminals or channels on 1 unconditioned line. The Micro4000 model 4096/4+ multiport modem can support up to four 2400-bps synchronous terminals communicating with a remote computer over a single leased phone line, carrying data at 9600 bps. Up to 4 high input channels—operating at 2400, 4800, 7200, or 9600 bps—can be supported as long as the aggregate composite data rate does not exceed 9600 bps. More elaborate configurations, such as connecting a string of multidropped terminals to each of the modem's input channels, are also possible.

Model 4096/4+ complies with CCITT Recommendation V.29 and offers downline loading of channel and composite link parameters (eg, operating speed). Other features include front panel indicators that display the status of any selected channel, independent local and remote loopback tests for any selected channel or the composite link, and individual channel buffering and control signal passing for linking other communications equipment to the modem. ***Micom Systems Inc,*** 20151 Nordhoff St, Chatsworth, CA 91311. **See at Booth W6496** **Circle 238**

Low cost Videotex terminal

VP-3501 includes both built-in direct connect modem for communication via phone and a modulated rf output for display of information on an ordinary TV. Features include color graphics, resident ASCII or dynamically redefinable character set, reverse video, tone generator with subcarrier audio output for sound through the TV, software selectable large character format, and expansion interface for peripherals. Compatible with timesharing and database computer networks, the terminal accesses information services and allows users to write, store, and run their own programs in BASIC, Pascal, FORTRAN, and COBOL with timesharing systems.



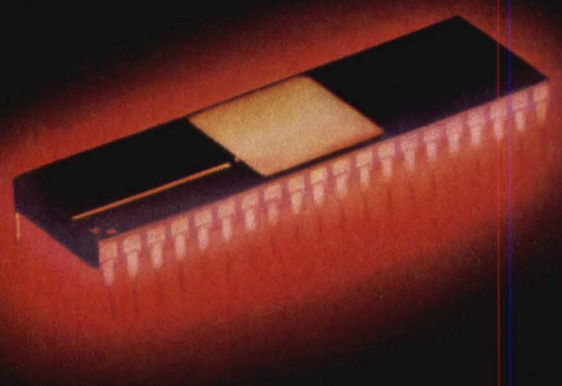
The terminal includes both 58-key alphanumeric keypad with 2 user keys and 16-key calculator format keypad. Built-in 300-baud modem connects directly to phones; plug-in acoustic coupler is optional. Color graphics allow individual characters and background to be displayed in 1 of 8 software selectable colors. Color locking circuits give sharp graphics and rainbow-free characters. Built-in tone and white noise generator can be programmed for end of line bell, error messages, prompts, sound effects, or music. Switch-selectable configuration control includes line/local, upper case only, full/half duplex, mark/space, and even/odd parity. ***RCA MicroComputer Products,*** New Holland Ave, Lancaster, PA 17604. **See at Booth W6580** **Circle 239**

Acoustically coupled modem

LEX-11 is a 300-baud asynchronous modem that interfaces through an RS-232 connector to computer or terminal, and transmits and receives through regular telephone handset. Battery power option allows it to be used with battery powered handheld terminals to communicate with a computer wherever a phone exists, even from a phone booth. It will talk with any Bell 103A modem. The unit provides data speeds up to 300 bps, originate or answer (switch selectable), full or half duplex (switch selectable), and receiver sensitivity of 47 dBm. It is EIA-RS-232C interface compatible and supplies loop back self-test, ready (carrier) indicator, power-on indicator, and battery power option. ***Lexicon Corp of Miami,*** 1541 NW 65th Ave, Fort Lauderdale, FL 33313. **See at Booth P8004**
Circle 240

INTEL INTRODUCES TURBO-CHARGED MICRO-PROCESSING.

THE FASTEST, EASIEST, MOST EFFICIENT WAY TO BOOST SYSTEM PERFORMANCE.



Introducing a revolutionary advancement in microprocessor system design.

Intel Coprocessors.

They work much like a turbocharger in an automobile. Dramatically increasing the power of your CPU, by "kicking-in" whenever specific functions are required.

Intel Coprocessors are an architectural triumph. Processor extensions. Beyond peripherals. They're designed for complete compatibility with Intel microprocessors, boards and systems.

Everything that's needed to boost your power is on one chip. Not a bag of parts.

And no "kludge" of parts can equal the performance, the ease of use, or the cost effectiveness.

There's the 8087 and the 80287 Numeric Coprocessor. Made to work with the Intel iAPX 86 family of 8 and 16-bit processors. Both Coprocessors have the power to accelerate your floating point math calculations an incredible 50 to 100 times. Eliminating the need for a minicomputer in the process.

And there's the 8089 I/O Channel Coprocessor. Capable of tripling your performance in the I/O-intensive parts of your application. Such as in hard disk control and communications.

Intel is the only company with a family of Coprocessors. For the component, board and system level. All being delivered in production quantities, now. With new types of Coprocessors on the way.

Like the 82730 Text Coprocessor. The first VLSI solution for fast manipulation and display of high-quality text.

And the 82586 LAN Coprocessor. Replacing 100 IC's for Ethernet,* or other Local Area Network designs.

The competition has yet to produce their first Coprocessor.

Typical Performance Improvements with Math Coprocessor (All Clock Speeds 8 MHz.)

	8086	8086 + 8087
Double Precision (64 bit) Floating Point Multiply	*1,313 μS*	*17 μS*
Interest Rate Calculation	*628 mS*	*.66 mS*
3-D Graphics Image Generation	*90.5 seconds*	*1.78 seconds*
FORTRAN Whetstone Calculations	*3K Whetstones per second*	*169K Whetstones per second*
Real Matrix Multiply	*134 seconds*	*4.08 seconds*

Discover just how powerful and cost-effective Coprocessors can be.

For complete documentation, including application notes, call us toll-free. **(800) 538-1876.** In California, **(800) 672-1833.** Your information will be on its way in less than 24 hours.

Or write us. Dept. F3, 3065 Bowers Avenue, Santa Clara, CA 95051.

Or contact your Intel Sales Representative.

And don't be alarmed by our enthusiasm when you ask about Coprocessors.

We're just charged-up.

intel® delivers solutions

United States and Canadian Distributors: Alliance, Almac Electronics Corporation, Arrow Electronics, Avnet Electronics, Hamilton/Avnet, Hamilton Electro Sales, Harvey, Kierulff Electronics, Inc., L.A. Varah, MTI Systems Sales, Mesa Technology Corporation, Pioneer, Wyle Distribution Group, Zentronics. In Europe and Japan, contact your local Intel Sales Office.

*Ethernet is a trademark of Xerox Corporation.

See us at NCC Booth #3910

CIRCLE 54

What Makes A Supermicro Company Super?



Start With A Super Supermicro.

Like the Momentum 32/E,™ a powerful OEM business computer that truly earns its "supermicro" status by combining the high performance characteristics of a midrange minicomputer with the price of a micro.

In throughput benchmarks against the VAX 11/780,™ the 32/E performed to 80% of the VAX standard. And when you consider the relative price tags for the VAX 11/780 vs. the 32/E, that means you're getting 80% of the VAX's performance for 10% of the price.

Beyond performance, the 32/E features superior cost efficiency, configuration flexibility and ease of maintenance. It boasts the power of the 8 mHz M68000™ microprocessor, our proprietary Memory Management Unit that can enhance system performance by upwards of 20%, and direct-memory access that further improves system performance in multi-user environments.

Our One Unbending Standard: Flexibility.

We know that design flexibility is the key to an OEM's success. The multi-user, multi-tasking versatility of the System III UNIX™ operating system gives you that key. Furthermore, you can configure the 32/E for one full megabyte of memory. You can add a multi-bus interface and an SMD interface. There are slots for up to eight serial I/O controllers, each with two serial ports (RS232, Current Loop or RS422). And each serial card is interchangeable with a microprocessor-based intelligent communications controller for even greater system performance.

The compact, rugged steel enclosure is available in tabletop or rack-mount versions, each with internal subsections slide-mounted for easy access.

The Product Is The Bottom Line.

For OEMs, that means the product's performance, versatility and reliability and, of course, price. So when you consider computers, especially M68000- and UNIX-based computers, consider that no one offers a broader line than Momentum, from the super workstation 32/4™ to the super "workhorse" Momentum 32/E. Consider the record, 98.5% out-of-box reliability and support that is comprehensive and nationwide. And consider that we view every aspect of our operation as an extension of your operation, from the engineering and manufacturing to the quality control programs.

Unlike a lot of OEM companies that talk "warm and fuzzy" commitments to this and to that, we feel the only commitment that really counts is delivering a better product at a better price. And we feel it's the bottom-line reason for putting Momentum behind your system.

68000 is a trademark of Motorola Corporation.
UNIX is a trademark of Bell Laboratories.
32/E and 32/4 are trademarks of Momentum Computer Systems International.
VAX 11/780 is a trademark of Digital Equipment Corporation.

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Computer Systems International

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(408) 245-4033; Telex: 172509.
Regional Sales Offices:
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Chicago (312) 642-3005;
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See us at NCC Booth #D200 at the Disneyland Hotel Convention Center.

CIRCLE 55

ncc '83 product preview

data communications

Fiber optic multiplexer

A multichannel fiber optic multiplexer for transferring data to and from RS-232 terminal devices will handle 8 full-duplex RS-232 ports, with each channel operating up to 19.2k bytes/s in synchronous or asynchronous modes. Internal selection for the time division unit provides for baud rates of 1.2k, 2.4k, 4.8k, 9.6k, or 19.2k bytes/s on the synchronous channels as well as mixed synchronous and asynchronous operation.

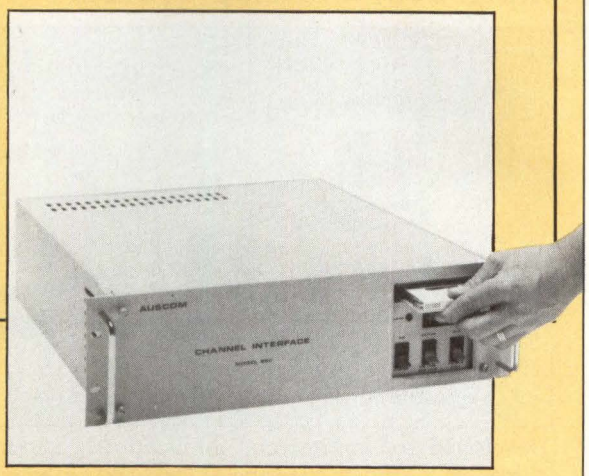
Front panel diagnostics provide electronically selectable digital loopback testing for each channel, and analog loopback selectable for main link testing. Activity indicators monitor traffic or loopback information on both received data and transmitted data lines. Main link continuity is monitored and displayed on a DCD indicator.

The Bit-Driver multiplexer uses fiber optic transmission methods with the capability of operating up to 6500′ (1981 m) over standard 227202 fiber optic cable. ***Belden Corp, Electronic Wire and Cable Div,*** 2000 S Batavia Ave, Geneva, IL 60134. **See at Booth P7118**



Circle 241

Mainframe to Ethernet interface

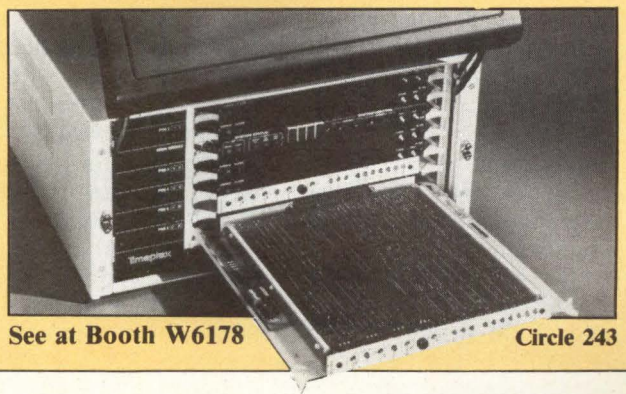


Model 8911 programmable IBM channel interface provides direct connection to an IBM mainframe as well as Ethernet hardware and software on the outboard side. Two versions of Ethernet drivers are currently available. The first implements Stop and Go Error Control Protocol. With the second protocol, data throughput rates of up to 200k bytes/s can be achieved if the receiving node supports expedient acknowledgment.

Software in the channel interface emulates a standard IBM control unit such as a 3803 mag tape controller or a 3272 local terminal controller. ***Auscom, Inc,*** 2007 Kramer Ln, Suite 102, Austin, TX 78758. **See at Booth P8124** **Circle 242**

Multiplexer modem option

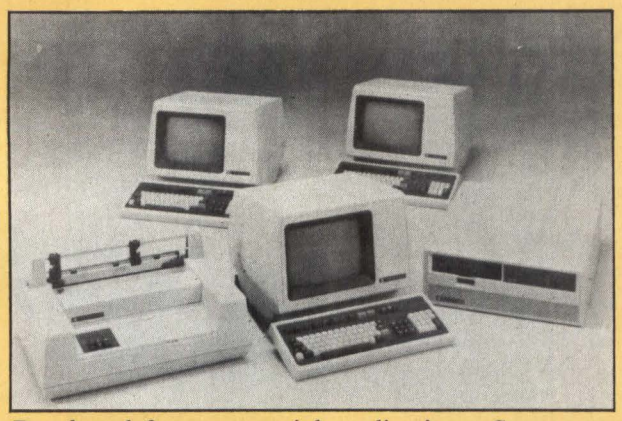
Users can integrate modems into the Microplexer® mainframe or expansion chassis, saving the space of external cabinets and eliminating a separate power supply. Data pumps are taken from advanced intelligent modems in speeds of 2400, 4800, and 9600 bps. These modems are compatible with CCITT standards V.26, V.27 bis, and V.29. Line termination and control circuits are on a carrier card that fits into the multiplexer's chassis, in the same slots as the I/O expansion modules. Any number of modems up to the number of unused channel card positions can be installed. The data pump itself slides into rails and a connector on the carrier card; this allows the line to remain terminated even when the pump is removed for inspection or reconfiguration. The internal modem draws power from the MUX frame; all signal leads are brought out to connectors on the rear of the chassis cabinet. This arrangement allows the modem to be patched to a data link or synchronous tail circuit on a channel port. It can also be used independently. ***Timeplex, Inc,*** 400 Chestnut Ridge Rd, Woodcliff Lake, NJ 07675.



See at Booth W6178 **Circle 243**

computers

Multi-user desktop system



Developed for commercial applications, System 300 comes in 5 models offering a TMS99000 based single-board CPU, 128K bytes of error correcting main memory expandable to 512K bytes, and mass storage options from 5M to 43M bytes. Each system includes a Winchester disk subsystem for program and data storage; 4 disk subsystems can be daisy chained to provide 172M bytes maximum. Memory functions are performed using 64K DRAMs; this reduces the number of chips for a given size and thus improves reliability.

The 12" (30-cm) video terminal has 80-col x 24-line display and detachable keyboard with a full 128-char ASCII set, 8 programmable function keys, and a 10-key numeric pad. An optional 2-channel communication board expands each computer into a 3-terminal system supporting 3 printers. The communication board also supports the 3780/2780 communication software package for remote job entry with IBM and other host computers.

The company's general purpose, multi-user DX10 operating system supports BASIC, COBOL, FORTRAN, and Pascal languages. Application software handles general ledger, accounts payable, accounts receivable, inventory control, payroll, and word processing. In addition, UCSD's p-System provides for interactive software development and allows the computer to run applications written for other microprocessors. ***Texas Instruments Inc,*** PO Box 202146, Dallas, TX 75220. **See at Booth S5028** **Circle 244**

2-MIPS multiprocessor mainframe

Large scale, virtual memory T85LVM executes realtime tasks in a multimode, multiprocessor, multi-user environment. The central processor's 32-bit parallel ALU performs binary, floating point, logical, or decimal operations in double-word (64-bit), word (32-bit), half-word (16-bit), and byte (8-bit) formats. The CPU supplies up to 16 register blocks, each containing up to 16 general purpose registers. Memory cycle interleaving and overlapping provide computation speeds over 2 MIPS, depending on application and system configuration.

System accommodates up to 16M bytes of virtual memory, using 32M bytes of physical memory with 12 access ports and 4 memory banks. This allows 4 CPUs to run at full speed, concurrent with all required I/O, without performance degradation. In the 4-processor configuration, the system provides fault-tolerant multiprocessing for critical installations or applications. Disk memory comes in removable-pack configurations with up to 315M bytes/drive; Winchester technology allows up to 673M bytes/drive and 1.2M-byte/s transfer rates. Other features include 4 realtime clocks, 16 internal and up to 112 external priority interrupt levels, and power fail-safe/memory protection.

Operating software is an enhanced version of CP-V. A multi-user, multiprocessing system, V/LVM supports programs with up to 16M bytes of virtual address space. Data processing functions can be handled in 5 concurrent modes: multiprogrammed local batch, remote batch, timeshared, transaction, and real time. Supported programming languages include APL, BASIC, COBOL, FORTRAN, and Pascal; the company provides a variety of standard application software packages. ***Telefile Computer Products, Inc,*** 17131 Daimler St, Irvine, CA 92714. **See at Booth W6234** **Circle 245**

NOTE: "A" series booths are located in Anaheim Convention Center's Arena, "N" series in the North Hall, "S" series in the South Hall, and "W" series in the Southwest Hall. "P" series booths are in the NCC Pavilions adjacent to the Registration area. "D" series booths are located in the Disneyland Hotel Convention Center.

TANDON ADMITS NO ONE COMPANY CAN HANDLE ALL YOUR DISK DRIVE NEEDS.

THAT'S WHY WE'RE THREE COMPANIES.

No company that builds a wide range of disk drives can provide the same efficiency and economy as a manufacturer that specializes in doing one thing better than anyone else.

Delays on one product affect the other lines. Inventory and labor costs are difficult to control. Research and development lag, and what was once leading edge technology becomes yesterday's news.

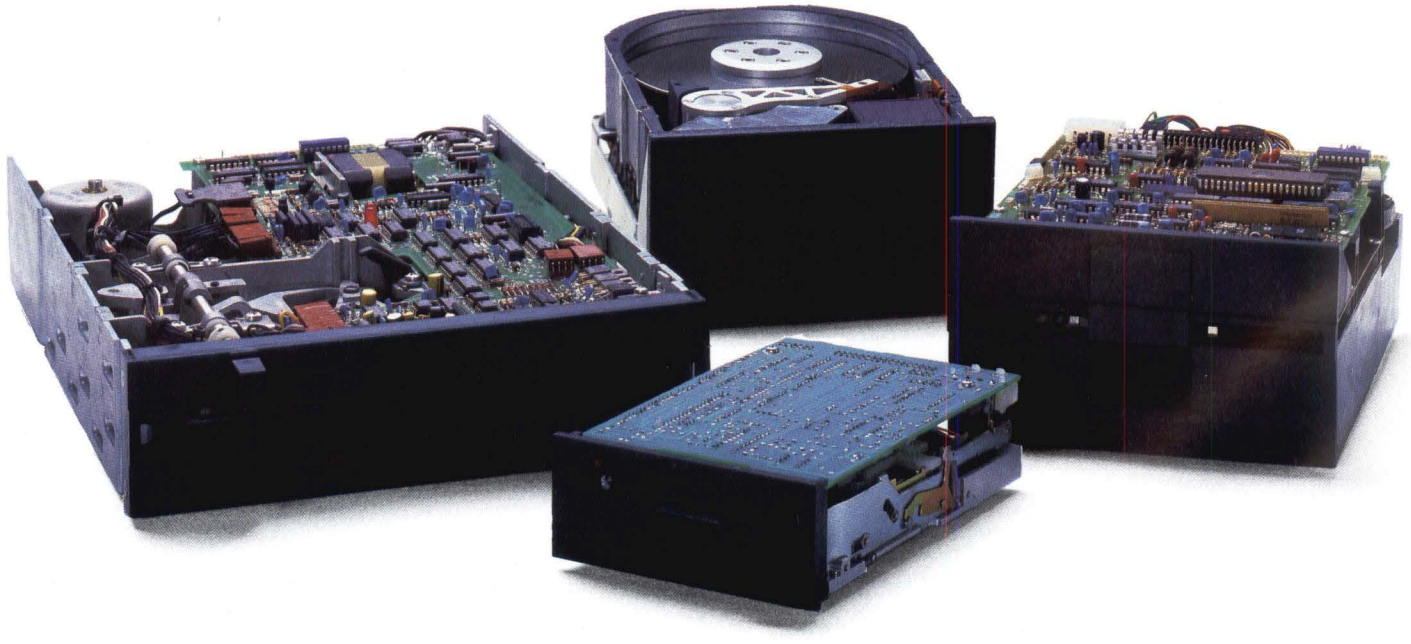
That's why Tandon Corporation, from its inception, has organized itself as a series of companies by product line.

There's our 5¼" Floppy Company. Our 5¼" Winchester Company. And our 8" and 3½" Floppy Company.

Each is an autonomous entity, a specialist in its own complex field with all the resources of a separate company from purchasing to engineering and quality control. Our companies can concentrate their energies on producing what they know best better than anyone else in the business. That concept is what's made each a world leader in its particular product line.

Our companies are all free to organize themselves internally to maximize their efficiency and economy and to allow them to respond rapidly to their fast-changing markets. They each do things a little differently. But all three are the most successful disk drive companies you ever heard of.

And they're all named Tandon.



Tandon

5¼" FLOPPY COMPANY

20320 PRAIRIE STREET
CHATSWORTH, CALIFORNIA 91311

Tandon

5¼" WINCHESTER COMPANY

49 STRATHEARN
SIMI VALLEY, CALIFORNIA 93065

Tandon

8" AND 3½" FLOPPY COMPANY

375 CONEJO RIDGE AVE.
THOUSAND OAKS, CALIFORNIA 91360

TO BECOME THE WORLD LEADER IN 5¼" FLOPPIES, IT TOOK A LOT OF DRIVE.

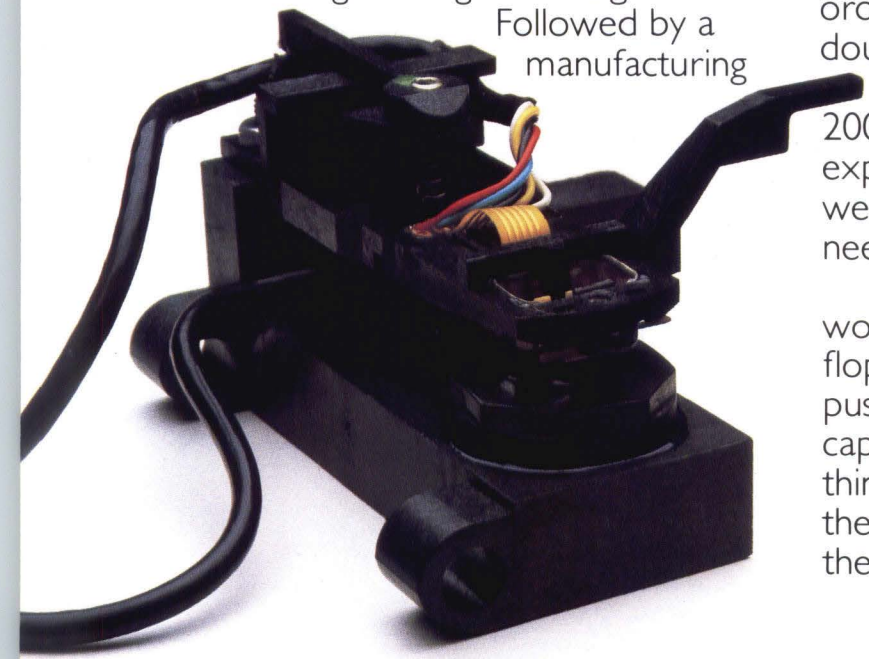
And the Tandon 5¼" Floppy Company has plenty of drive. Both in terms of ambition and in terms of product.

Tandon's unique corporate structure lets us focus our drive on one goal: to build more of the best possible 5¼" drives than anyone else in the world. At the lowest possible cost.

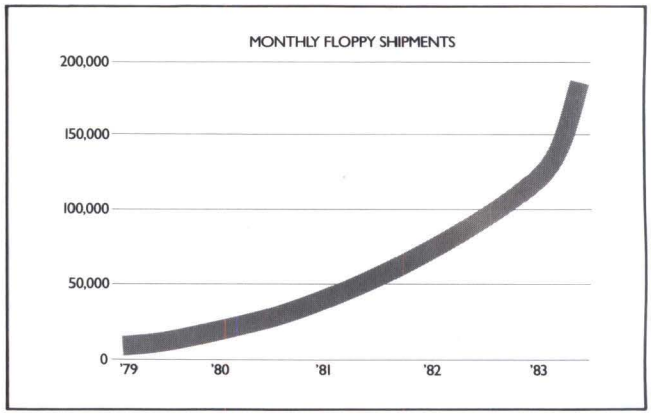
And that's just what we've done. In less time than anyone but Tandon thought possible, we've become the biggest name in 5¼" floppies. Even bigger than such established names as... well, you know who they are. And so do they.

But all the drive in the world wouldn't have made us number one if we didn't have the product to back it up.

We do. Starting where it counts, with innovative engineering and design.



Followed by a manufacturing operation that features the highest degree of vertical integration in the industry. 80% of the material cost of our drives consists of parts we manufacture ourselves. So we can keep far tighter control over quality and cost. And avoid what other companies call "unavoidable supplier-caused delays."



Our aim is always to maintain production capacity higher than actual orders. Last year, we more than doubled our production capacity with facilities that can easily exceed 200,000 drives a month. In 1983, we are expanding still further. To be sure that we can always deliver the drives you need, when you need them.

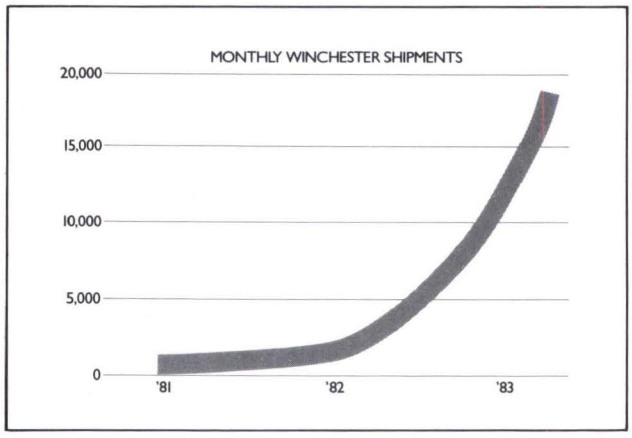
That's how we plan to stay the world's number one supplier of 5¼" floppy drives. By building drives that push the limits of performance and capacity further than our competitors think possible. In greater numbers than they can produce. At lower costs than they can match.

TANDON 5¼" FLOPPY COMPANY.



WE DON'T MEASURE WINCHESTER CAPACITY JUST IN MEGABYTES.

We measure it in terms of production capacity. Capacity for technological innovation. And capacity for building-in quality at the lowest possible cost.



We're the Tandon 5¼" Winchester Company. And we're at a disadvantage. Unlike our Tandon sister companies, we're not the world's production leader in our field. We're only number two. Though not by much. Like the Tandon 5¼" Floppy Company, we didn't start first, but we intend to finish first.

We build a wide range of drives. Open-loop and high performance closed-loop models. Right now, we have the capacity to build and ship 60,000 drives a month. That means that we have the capacity in place to be number one in 5¼" Winchesters. And we intend to be. By offering you what no other Winchester manufacturer can.

No other Winchester company makes so many of the parts that go into its drives.

No other Winchester company builds its own heads.

No other Winchester company manufactures more of its own plated media and its own PC board assemblies.

Our innovative products are backed with a 105% guarantee. Including our brand-new half-height 5¼" drives. With 6.4 and 12.8MB in half the space of traditional 5¼" Winchesters.

We're dedicated to building more drives with more capacity in less space for less cost.

Which means we're dedicated to being the world's leading producer of 5¼" Winchesters.



TANDON 5¼" WINCHESTER COMPANY.



OUR SMALLEST ACHIEVEMENT IS THE INDUSTRY'S BIGGEST SUCCESS.

The Tandon 8" and 3½" Floppy Company is the world's largest producer of 8" ThinLine™ drives.

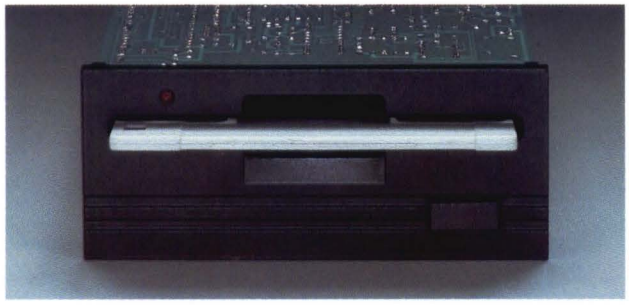
And now we're ramping up for high volume production of single and double-sided 3½" drives.

When we introduced the half-height 8" floppy drive, we expected system designers to go wild over it.

You did. Some of you stacked two of our drives to double system storage to as much as 3.2MB without increasing system size. Others took advantage of our small achievement to reduce system size instead.

Whatever you've done with our ThinLines, we want to thank you for having the confidence in them to give us an overwhelming lead in the half-height 8" market.

Now we're using our experience in making drives small to make them even smaller.



Our new 3½" drives are now in production in four versions. 500K byte single-sided and 1MB double-sided Tandon interface models. And Sony interface-compatible drives of the same capacities.





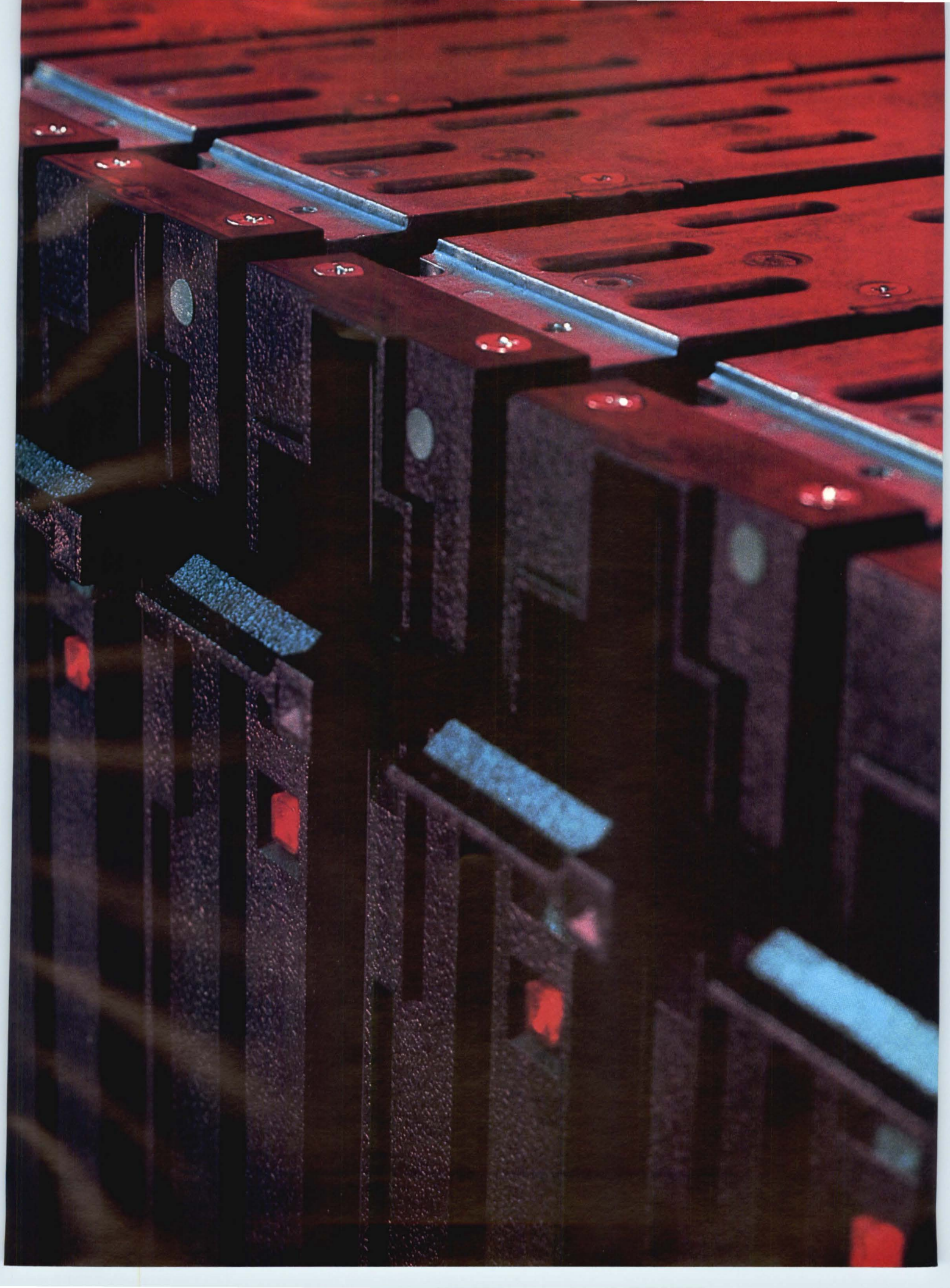
We plan on becoming the world's leader in 3½" the same way we became the world's leader in half-height 8." By focusing our energies on building more drives, better, at a lower cost than anyone else.

Like all Tandon companies, we start with a high degree of vertical integration. And an aggressive commitment to R&D no one can match.

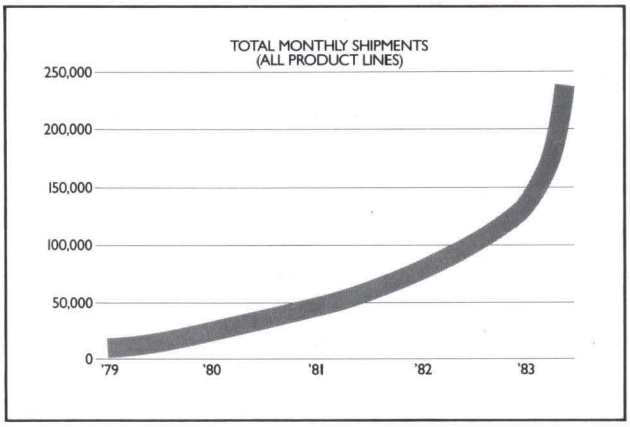
We've also established ourselves in a brand-new facility with all the latest manufacturing and test equipment. So we can triple our current leading monthly production rate while ramping up to meet the burgeoning 3½" market.

Just because we've become a success by thinking small doesn't mean our plans are modest.

TANDON 8" AND 3½" FLOPPY COMPANY.



WE MAKE 24 DRIVES A DAY. NO WONDER WE'RE THE WORLD'S PRODUCTION LEADER.



With 24 different drive models in production each and every day, it's not surprising we're the number one supplier of micro peripheral disk drives in the world.

We're producing upwards of 10,000 drives every business day. Over 200,000 a month. And at this rate more than 2½ million drives a year.

Here's how the Tandon Companies have become the most successful disk drive companies you ever heard of:

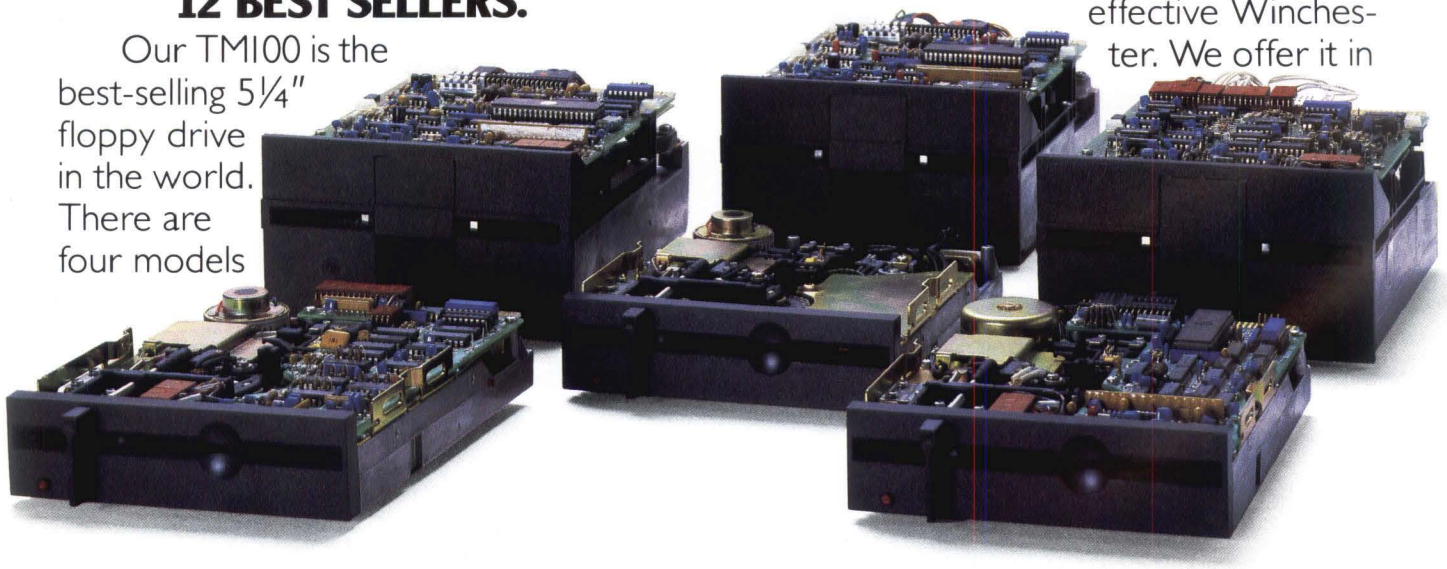
TANDON 5¼" FLOPPY COMPANY. 12 BEST SELLERS.

Our TM100 is the best-selling 5¼" floppy drive in the world. There are four models to choose from. 48TPI with 250KB. 48TPI with 500KB. 96TPI with 500KB. And 96TPI with 1MB. Our TM101-4 is a microprocessor-controlled model offering 96TPI with 1MB. And our TM102-2 has 96TPI with a full 2MB capacity.

Then there are our half-height 5¼" ThinLine floppies. Our ultra low cost TM50 comes in four versions. Two mechanics-only models for high-volume OEMs who want to provide their own added value and two models with fully operational electronics. Both versions come in 48TPI 250KB and 500KB capacity models. For microprocessor-controlled performance, our two model TM55 5¼" ThinLines offer 48TPI with a 500KB capacity and 96TPI with a 1MB capacity.

TANDON 5¼" WINCHESTER COMPANY. 6 DRIVES IS JUST THE BEGINNING OF OUR CAPACITY.

Our TM500 is an exceptionally cost-effective Winchester. We offer it in





three models: 6.4MB, 12.8MB, and 19.2MB unformatted capacities. Our TM703 is a high-performance, closed-loop 5¼" drive with a full 30MB of storage.

We're proudest of our new TM250 half-height 5¼" Winchester. It's available now in 6.4MB and 12.8MB versions. With all the performance of a full height Winchester in half the space.

TANDON 8" AND 3½" FLOPPY COMPANY. 6 SMALL DRIVES. NO SMALL ACHIEVEMENT.

Our TM848, our first half-height 8" floppy, is still the world's best seller. It comes in two models. 48TPI single-sided with 800KB capacity and 48TPI double-sided with 1.6MB of storage.

Our new TM35 3½" drives are available in four models. Two Tandon TM100 interface-compatible versions—500KB and 1MB. And two Sony interface-compatible versions—also 500KB and 1MB capacities.



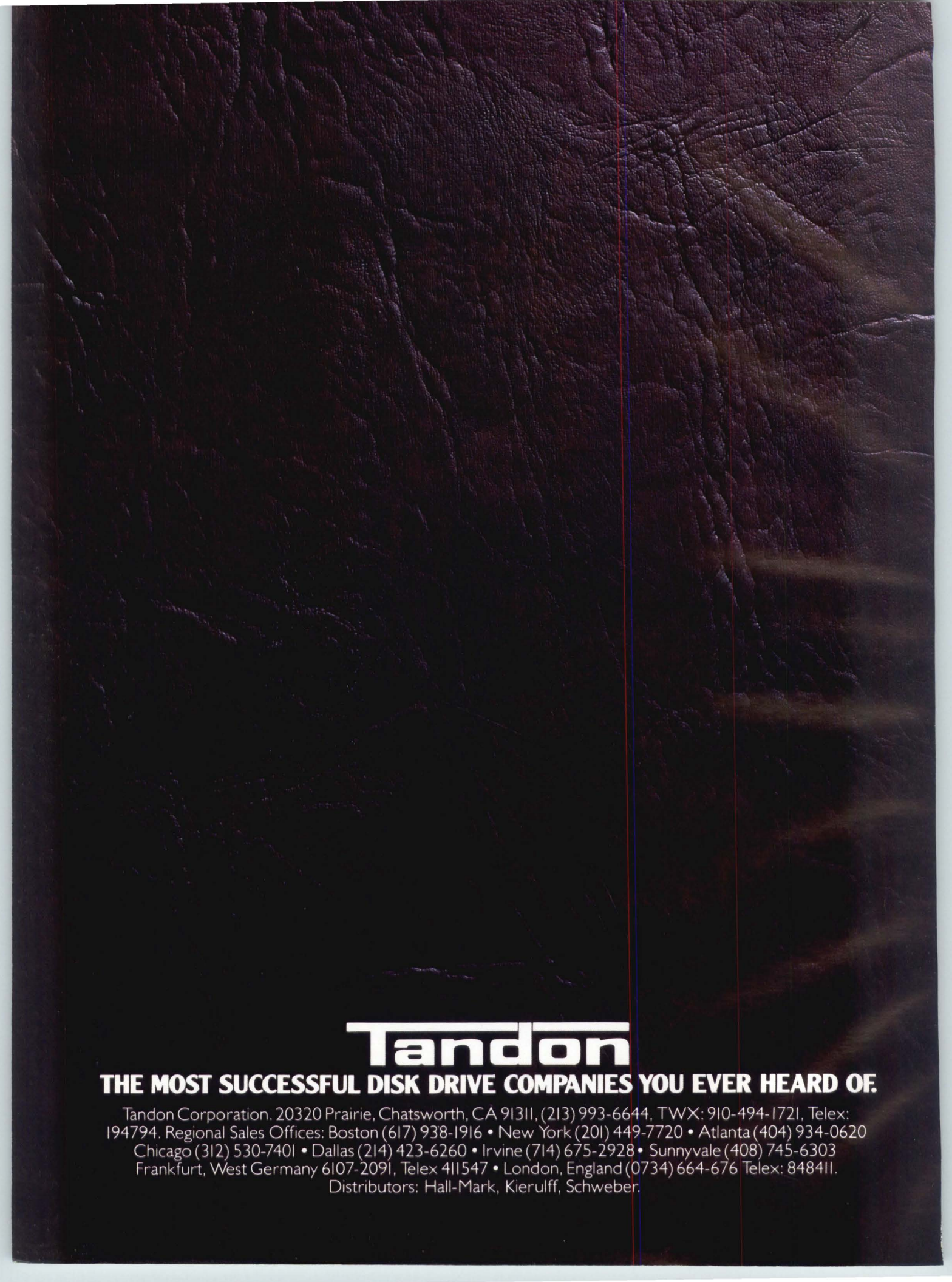
THE TANDON COMPANIES. THE DIFFERENCE IS OUR SUCCESS.

Separately, we offer products no competitor can match. Together, we're a corporation that has doubled or tripled its growth every year for the past 5 years.

Buying from the Tandon Companies offers you all the advantages of buying from a single source. *And* all the advantages of buying from a supplier who has concentrated all its resources on doing one job better than anyone else in the world.

That's the Tandon philosophy. It's given us an all-important edge on our competitors. And it's made us the most successful disk drive companies you ever heard of.

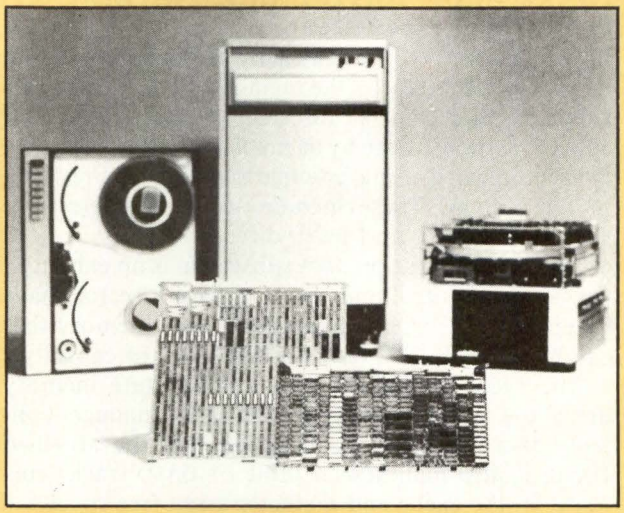
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THE MOST SUCCESSFUL DISK DRIVE COMPANIES YOU EVER HEARD OF.
Tandon Corporation. 20320 Prairie, Chatsworth, CA 91311, (213) 993-6644, TWX: 910-494-1721, Telex: 194794. Regional Sales Offices: Boston (617) 938-1916 • New York (201) 449-7720 • Atlanta (404) 934-0620 Chicago (312) 530-7401 • Dallas (214) 423-6260 • Irvine (714) 675-2928 • Sunnyvale (408) 745-6303 Frankfurt, West Germany 6107-2091, Telex 411547 • London, England (0734) 664-676 Telex: 848411. Distributors: Hall-Mark, Kierulff, Schweber.

interface

Single-board disk/tape controllers

Replacing separate disk and tape controllers, multifunction controllers support SMD disk drives with up to 2M-byte/s transfer rates and ½" magnetic tapes with rates up to 320k-bytes/s. Both start/stop and streaming modes are accommodated. Dual bipolar 2901-type microprocessor design simultaneously controls CPV, disk, and tape interfaces. Modularity simplifies configuration changes. Separate buffers for disk (3 sectors) and tape (64 bytes) allow concurrent data transfers while eliminating disk data late errors. Model 20 for DG computers emulates DG 6067 disk and 6021 tape subsystems under RDOS, AOS, IRIS, and BLIS/COBOL. Model 21 for DEC PDP-11 and VAX emulates RM02/05, RK07 disk, and RM11, TS11 tape subsystems under RSX-11M, –11MPLUS, RSTS-E, VMS, and UNIX. Model 26 for TI 990 and 600 series emulates CDI1400, DS80/300 disk, and TI 979 tape subsystems.



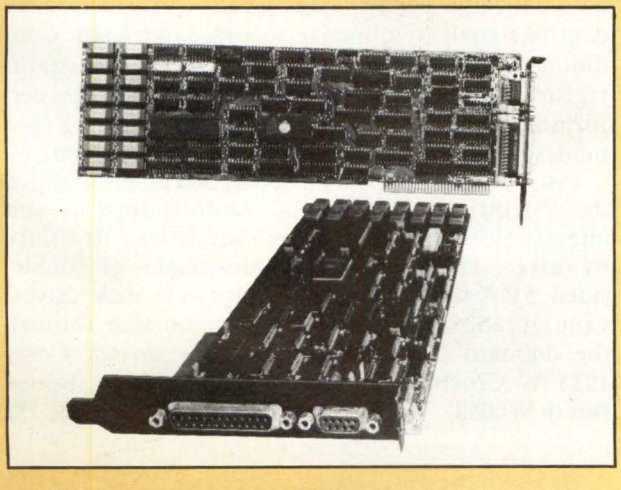
Spectra Logic Corp, 1227 Innsbruck Dr, Sunnyvale, CA 94086. **See at Booth N4920** **Circle 246**

Streaming tape interface

DU132 intelligent coupler supplies low cost streaming and start/stop tape backup for DEC PDP-11/34 through /70 and VAX-11/750, /780, and /782 computers. A TS-11 emulating device that interfaces with either ½" start/stop formatted 9-track tape transports or streaming transports with embedded formatters, the coupler permits data transfer rates of up to 200k bytes/s with tape speeds to 125 ips. When used in start/stop mode, it is completely software compatible with DEC VMS, RSTS/E, RSX-11M, and RT-11 operating systems. A standalone utility software package accommodates streaming transports.

Based on a high speed bipolar microprocessor, the board provides large control store memory to handle data manipulations, adhering to timing limits and bus loading specifications. All data, address, and control signals are parallel transferred between the coupler and host via the Unibus. A 1k-byte buffer virtually eliminates data late errors. ***Distributed Logic Corp,*** 12800 Garden Grove Blvd, Garden Grove, CA 92643. **See at Booth A3313**
Circle 247

Multiple adapter interface



A single plug-in board provides memory extension, monochrome or color video, and a printer adapter for the IBM Personal Computer. The MAI module contains 128K bytes of DRAM that the user allocates by flipping a 2-position DIP switch. One setting configures the board for monochrome video display or color graphics applications; the other allocates 96K bytes to user memory (leaving 32K for video mode) or 128K bytes to video mode.

The board operates in 40 x 25 or 80 x 25 alphanumeric, 320 x 200 4-color, or 640 x 200 black/white mode. Special screen memory configuration provides for 320 x 200 16-color, 640 x 200 4-color, 320 x 400 4- or 16-color, or 640 x 400 4-color or black/white mode. A high resolution lightpen circuit achieves 0.5- or 1-dot resolution. Char set comes in one erasable ultraviolet PROM. ***Amdek Corp,*** 2201 Lively Blvd, Elk Grove Village, IL 60007. **See at Booth P7638**
Circle 248

interface

Disk/cache buffer control unit

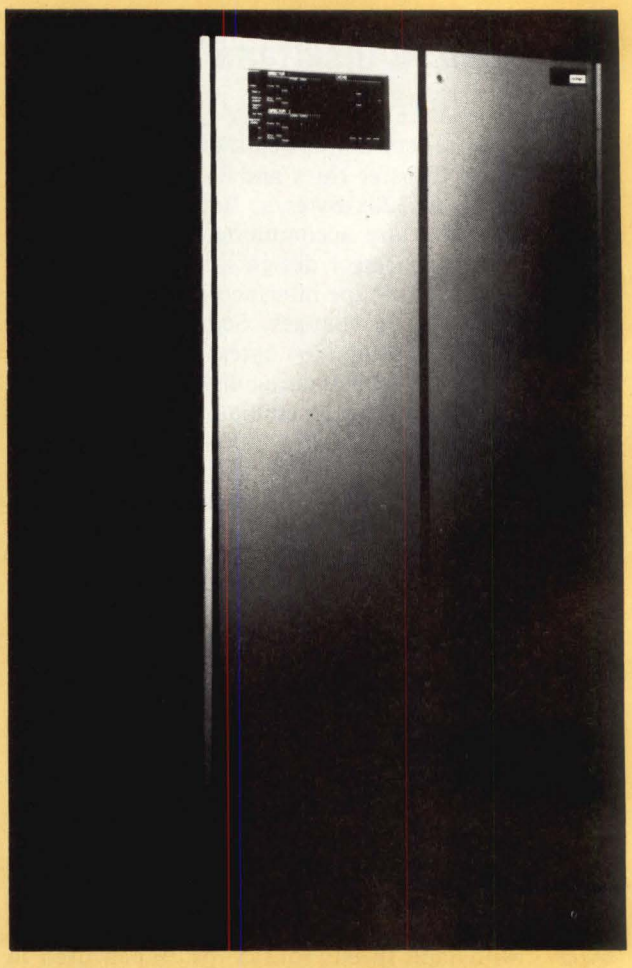
Improving I/O response times by prestaging data to a large semiconductor cache memory, Syber Cache 8890 supports data transfer rates up to 3M bytes/s and cuts I/O response time by as much as 75%. Prestaging is accomplished using intelligent algorithms residing in the system. These include sequential detection, cache every read, and DASD direct.

The 8890 application data subsystem is an enhanced 8880-2 DASD control unit. Both storage directors have independent access to a semiconductor memory that can have 1.5M, 3M, 6M, or 12M bytes of capacity.

The cache is divided into a solid state memory array and a cache manager. The cache manager controls data memory, I/O channel, and the attached DASD; it also maintains a table of DASD tracks currently in the cache and manages array free space.

On read request demand, the unit moves DASD device tracks containing blocks of data into frames of a large RAM. Write operations are executed directly to the actual DASD device; if the track written was in the cache, it is flagged as invalid to guarantee data integrity. Cache operations are completely transparent to the host. All data buffering is initiated and controlled entirely within the subsystem.

Standard I/O features such as I/O error alert, command retry, and reserve/release are also supported. The subsystem supports string switch, dual-port, and nonswitched ports. ***Storage Technology Corp***, 2270 S 88th St, Louisville, CO 80028. **See at Booth S5184**
Circle 249



Dual printer controller

A DMA controller for DEC VAX systems emulates 2 separate DEC DMF32 printer controllers and supports 2 printers with separate addresses and different print speeds on each quad board. The DLP-1132 will support 2 printers concurrently at any speed through 2000 lpm each.

The controller is equipped with 2 functions that verify correct operation and isolate line printer system problems. An internal self-test checks over 90% of the controller logic, printer cable, and displays any failure via LEDs. Then an external self-test verifies printer and cable operations. Printer subsystem integrity is ensured by the self-test capability that can produce an extensive printout of internal controller status. The DLP-1132 operates with all printers using Dataproducts or Centronics interface standards. ***Datasystems Corp,*** 11072 Willow Creek Rd, San Diego, CA 92131. **See at Booth P7128**
Circle 250

VMEbus boards

VME-SASI interfaces the VMEbus and the Shugart Associates System Interface (SASI), monitoring and automatically acknowledging all SASI handshake control signals to minimize software overhead. Condition of the interface is available through a status register. Data transfers with a controller can be performed on a programmed byte basis or by using DMA modes. Multiple boards can be used in a system.

VME-FDC is a floppy disk drive controller board for the VMEbus. It provides all control, format, and interface logic between the bus and from 1 to 4 floppy drives. The controller handles single- or double-sided 5¼″ or 8″ Shugart compatible disk drives. Configuration controls are programmable through the onboard drive control register. ***Mostek Corp,*** 1215 W Crosby Dr, Carrollton, TX 75006. **See at Booth W6088** **Circle 251**

New Amdek 3″ micro-floppydisk drive system!

AMDISK-III . . . the engineer's choice:

- New 3″ hard plastic encased diskette.
- Up to 1 megabyte storage. (unformatted)
- Plug-in compatible with 5¼″ drives.
- Compatible with - IBM-PC.



Specifications

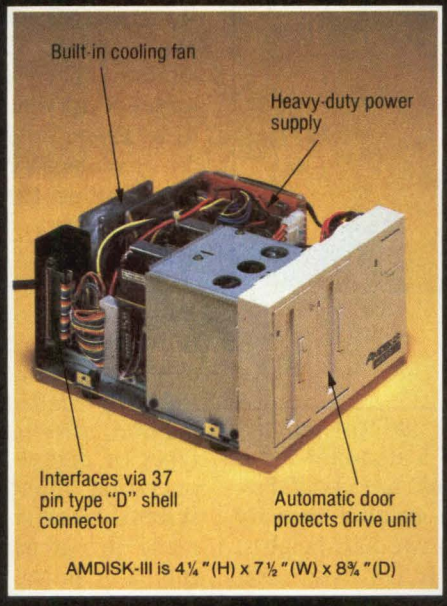
	Unit	Double Density
Capacity		
Unformatted Per Surface	Bytes	250K
Media		
Record Surfaces	2	
Tracks	80	
Recording		
Max Recording Density	Bpi	8946
Track Density	Tpi	100
Transfer Rate	bits/sec	250K
Access Time		
Average Access Time	msec	55
Track to Track	msec	3
Setting Time	msec	15
Average Latency Time	msec	100
Motor Start Time	sec	1
Disk Speed	rpm	300
Reliability		
Error Rates		
Soft Error		10^{-9}
Hard Error		10^{-12}
Seek Error		10^{-6}
Media	3-inch Cartridge	
Drive Interface	Plug Compatible with 5.25 inch FDD	

External Interface

Connector: 37-pin "D" shell connector

Pin No.	Signal	Pin No.	Signal
1-5	Unused	13	Write data
6	Index	14	Write enable
7	Motor enable C	15	Track 00
8	Drive select D	16	Write protect
9	Drive select C	17	Read data
10	Motor enable D	18*	Select head 1
11	Direction	19	GND
12	Step pulse	20-37	GND

*drives are single head



AMDISK-III is 4¼″(H) x 7½″(W) x 8¾″(D)



Evaluation samples $480

Includes two-drive Amdisk unit with built-in power supply, 4 diskettes and application literature . . . Call (312) 364-1180.

The AMDISK-III Micro-floppydisk System is an engineering breakthrough in disk size, storage capacity, media protection and user convenience. Designed for microcomputers for many applications, the Amdek system is ruggedly constructed to provide years of trouble-free operation. Warranty is 90 days (parts & labor).

Put the new AMDISK-III to test . . . its recording format, data transfer rate and disk rotation speed are compatible with 5¼″ floppydisk drives. Call, or write for evaluation samples at only $480.00 . . . or circle the reader service number for full technical details.

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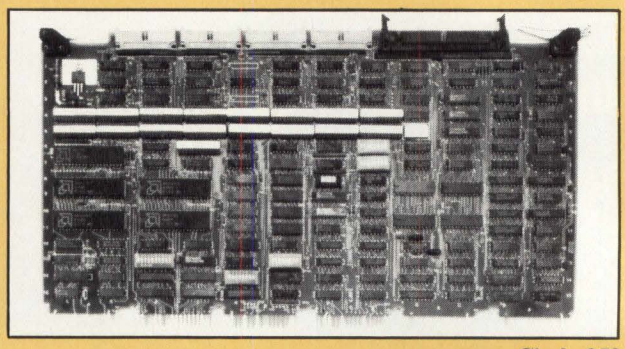
CIRCLE 57

interface

LSI-11 and PDP-11 disk controllers

Disk controllers for Unibus, Q-bus, and CMI bus computers emulate RM03/05 and RK06/07. The DFC 807 controller and the DFC 907 for LSI-11/23 computers provide complete transparency to all DEC operating systems and UNIX.

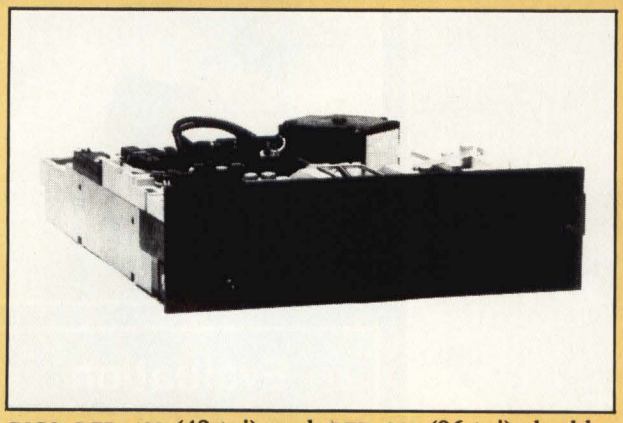
Model DFC 607 for VAX-750-CMI emulates RM03/05 and RP06. A controller for Q-bus computers is also available. The disk controllers for Unibus and CMI run Eagle drives. ***Aviv Corp,*** 26 Cummings Pk, Woburn, MA 01801. **See at Booth D2438**



Circle 252

memory systems

Half-height 5¼" floppy drive

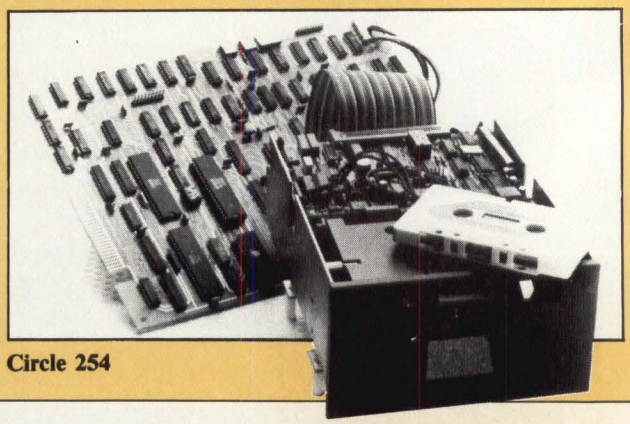


PICO RFD 485 (48-tpi) and RFD 965 (96-tpi) double-sided drives are half the height of a standard mini-floppy drive; single-sided versions are available. These drives allow users to expand existing capacity by replacing one full-size drive with two half-heights. Available capacity on the RFD 965 is 1M byte; 500k bytes on the RFD 485. Features include a self-centering clutch and spindle design that improves media to spindle registration and LSI circuitry that reduces the size of the logic board. The bezel is removable and interchangeable. Read/write heads are gently loaded onto and unloaded from the media surface via a mechanism engineered into door operation. "Push to open, push to close" door mechanics eliminate the head load solenoid. Track-to-track access time for the RFD 965 drive is 3 ms (5 ms for RFD 485); MTBF of the direct drive brushless motor is 30,000 h. Drives are ANSI and industry compatible. ***Ex-Cell-O Corp, Remex Div***, 1733 Alton St, Irvine, CA 92713. **See at Booth W6396**

Circle 253

Streaming cassette tape drive

Winchester Repeater series WR-100 is a QIC-02 compatible digital cassette recorder with 10M-byte formatted capacity. Overall dimensions and operating voltages are identical to those of 5¼" Winchester disk drives, allowing the unit to be installed as a direct replacement for a standard 5¼" floppy disk. The Philips cassette combines cost effectiveness, high reliability, compact size, convenience in loading and unloading, and interchangeability. Precise continuous control of tape speed and tape tension from BOT to EOT is maintained by the transport. Serpentine operation removes rewind delay, and media cost is less than that of competitive devices. The unit is useful for collection, normalization, storage, transmission, dissemination, and transportation of all types of digital data. Although streaming mode of operation mandates constraints in the operating system, transfer rate, capacity, and low error rate make this a practical unit. ***Raymond Engineering Inc***, 217 Smith St, Middletown, CT 06457. **See at Booth N4105**



Circle 254

The 1/2" Tape Backup decision made easy... with the Alternative to Streaming.

Use Microstreamer® where streaming software and systems applications permit...

Use CacheTape™ where they don't... for only $2,820*

Streaming or CacheTape — Your Choice

Cipher's CacheTape products are not just a new type of start/stop tape drive — they're much more. CacheTape goes beyond start/stop by incorporating a cache memory into the tape drive. The result: a systems approach to backup, which allows CacheTape to interact with the system as an easy-to-use tape drive without the performance limitations of streaming tape.

CacheTape is the alternative for backup when streaming is not feasible. By combining start/stop performance with streaming mechanics and such convenient features as fully automatic loading and compact package size, CacheTape provides the most cost-effective disk backup method for non-streaming system environments.

*OEM Quantities

Software Transparent

If you can't afford the time to develop streaming software and if your system applications won't support data streaming, CacheTape is your backup device.



Cipher's CacheTape products are completely software transparent with current vacuum column or tension arm start/stop tape software. Utilization of a cache memory in the tape drive means that CacheTape eliminates expensive software development time normally associated with streaming tape drives and still performs in transactional applications as well. Just plug CacheTape into your system now ... and benefit from total software compatibility.

Better Performance

CacheTape easily outperforms 100/25 ips streaming tape drives at 1600 BPI in start/stop applications.

	Measured Benchmark Time**
Streaming Tape (variable speed)	23.0 min.
CacheTape — Model 890	10.8 min.
CacheTape — Model 891	7.5 min.

**on a DEC PDP-11/34 under RSTS™ using file save routines for 16MB with 4K blocks

Call or write for a free benchmark brochure that explains performance advantages and how to evaluate in advance the benefits of CacheTape.

RSTS is a registered Trademark of Digital Equipment Corporation.

Tape Adapter Compatibility

CacheTape easily interfaces and operates with industry-standard tape adapters. With CacheTape, you can use your current controller investment wisely and effectively ... Plug in CacheTape for immediate benefits.

CacheTape...the streaming alternative

- **Low cost**
- **Start/stop performance**
- **Tape adapter compatibility**
- **No software changes**

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CIRCLE 58

SEE US AT NCC BOOTH W-6170

memory systems

Combined disk/tape subsystem

PXD51 series mass storage subsystems for DEC computers combines disk and tape capability in one 42" (107-cm) cabinet. The subsystem includes DEC compatible disk and tape controllers, the M2351A Eagle disk drive from Fujitsu Ltd, and the 92181 Keystone tape drive from Control Data Corp.

In addition to performing the usual backup functions, the tape unit offers archival storage and journaling capability plus the benefit of complete media interchangeability associated with ½" magnetic tape. The disk drive supplies program storage, data exchange, and system backup. Start/stop functions can be mixed with streaming.



The Eagle is a Winchester-type drive that transfers data at 1.8M bytes/s. The Keystone operates at 25 ips in start/stop mode and at 25 ips and 100 ips in streaming mode.

Models include PDP-11, VAX-11/730 Unibus, VAX-11/750 CMI bus, and VAX-11/780 SBI bus emulation. For PDP-11 and VAX-11/730 Unibus, PJD51/BX and /B3 store 414M bytes emulating an expanded RM80. For VAX-11/750 CMI bus, PCD51/B3 and /B2 store from 349M to 414M bytes emulating either 2 RP06s or 1 expanded RM80. PSD51/B3 and /B2 for VAX-11/780 SBI bus store from 349M to 414M bytes and emulate either 2 RP06s or an expanded RM80. ***Emulex Corp,*** 3545 Harbor Blvd, Costa Mesa, CA 92626. **See at Booth A3100** **Circle 255**

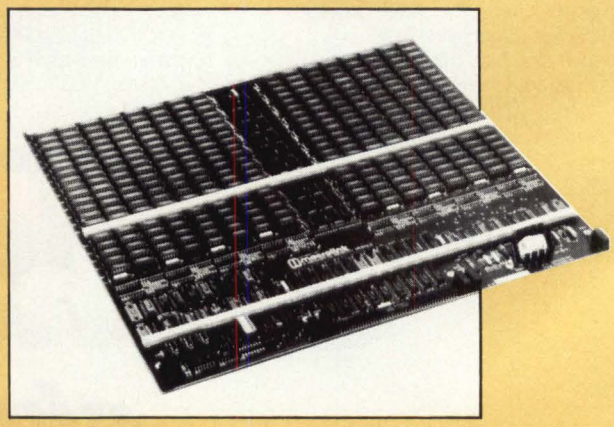
Streaming tape evaluators

Designed to speed integration of streaming ½" tape drives in Winchester backup applications, E series Evaluators permit designers to carry out full-scale file and restore operations at either 90 or 130 ips. This can be accomplished using the 160M byte D160 24-track streaming tape drive in conjunction with either low speed Q2000/SA1000 compatible interfaces or higher speed SMD interfaces. For comparison testing of backup devices in on- and offline modes, some units permit ¼" tape cartridge drives to be interchanged with the D160.

Each evaluation system consists of D160 ½" streaming tape drive, product and interface manuals, and cabling and connectors. An exerciser allows the designer to mechanically manipulate the drive, write data patterns, step the head, and analyze signals using an oscilloscope. A host processor is required to read and perform all logical operations. An intelligent controller supports both on- and offline data transfers between the system disk drives and ½" streaming backup device. ***Rosscomp,*** 16643 Valley View Dr, Cerritos, CA 90701.
See at Booth D2427 **Circle 256**

PE 2M-byte memory board

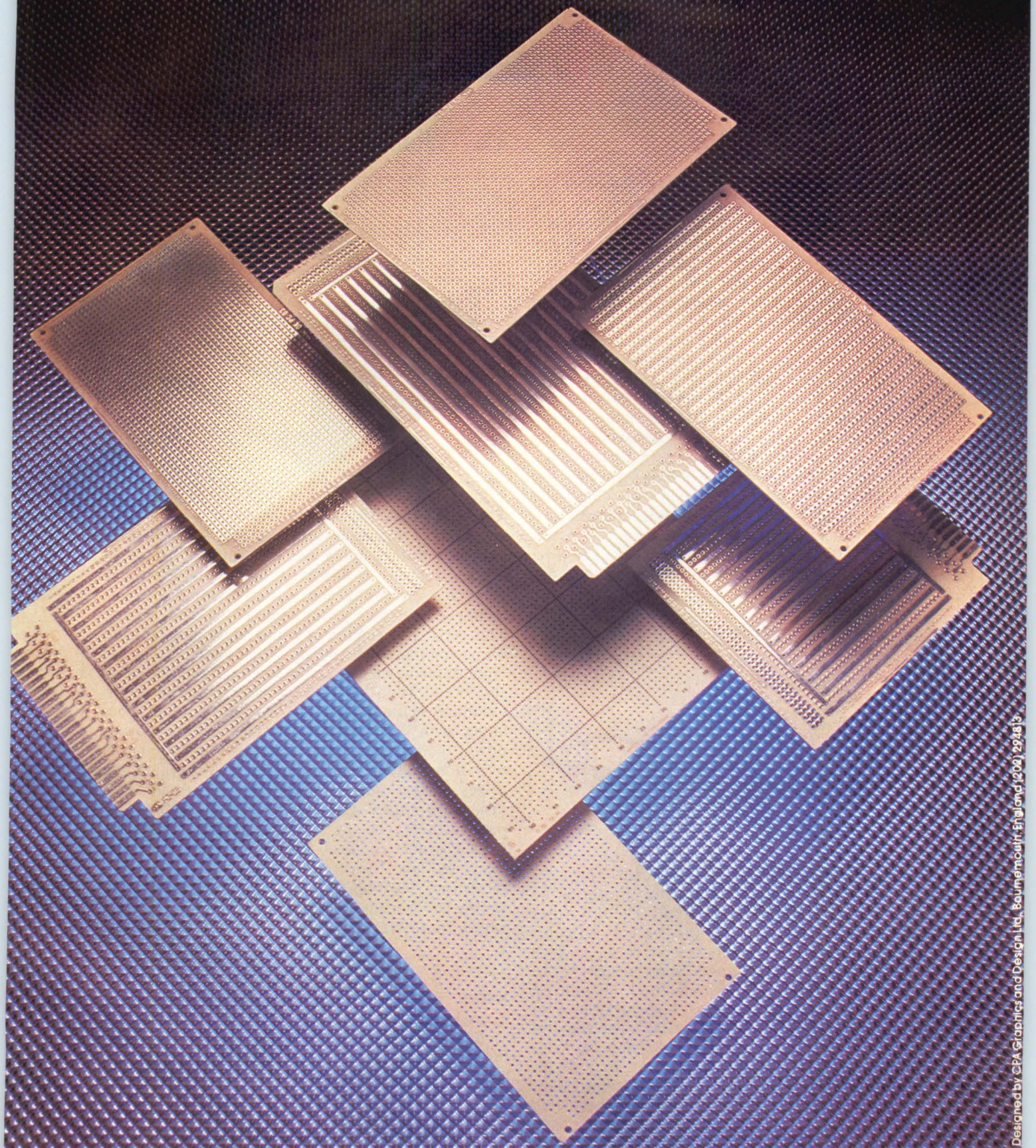
High density 1M-byte and 2M-byte memories are compatible with all Perkin-Elmer 3200 series computers. Using 64K RAMs, the boards offer 3240 users up to 8 times more memory per slot than previously available. Fault LEDs and a spare memory chip are included for ease of troubleshooting and rapid field repair.



The ready to install memory is fully computer tested, burned in, and then computer tested again before shipment. ***Macrolink Inc,*** 1150 Stanford, Ct, Anaheim, CA 92805. **See at Booth P7142** **Circle 257**

Board Meeting

A comprehensive range of
printed circuit boards are available from stock



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CIRCLE 59

Designed by CPA Graphics and Design Ltd., Bournemouth, England (202) 29813.

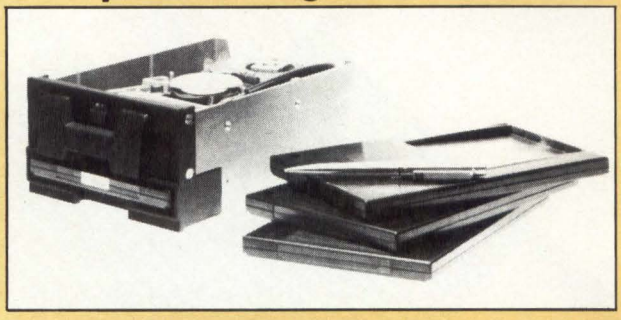
memory systems

1M-byte 8″ floppies

Model Z-207-42 stores 1M byte on both double-sided, double-density diskettes. A single-drive version, Z-207-41, upgrades to a dual drive. Half-height Shugart SA860 drives can be used with any desktop computer with an industry standard 8″ drive controller; drives are also IBM 3740 compatible. Track density is 48 tpi; track to track access time is 3 ms and average access time is 90 ms.

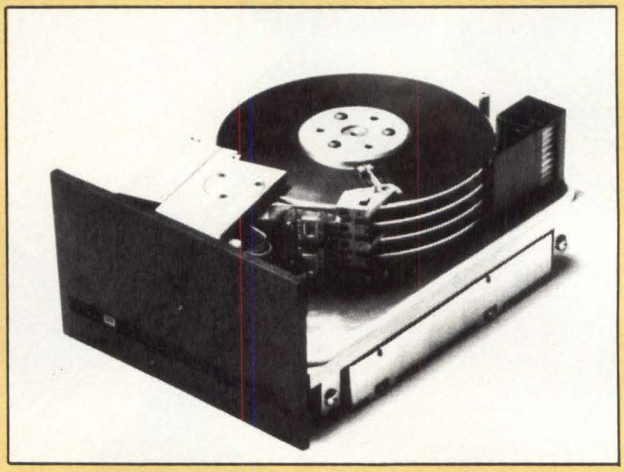
Also on display will be enhancements for the Z-100 computer, featuring a 256K IEEE 696 compatible dynamic RAM card and built-in 5″, 11M-byte Winchester disk drives. The Winchester drives come preformatted and prepartitioned, and feature built-in microprocessor intelligence, DMA or DMA memory transfer, and usability with other Winchester drives. A backup and restore utility enables users to select files created on or after a specified date. Controller card has error correction circuitry. All company software that runs on the Z-100 is usable on Winchester drives. ***Zenith Data Systems,*** 1000 Milwaukee Ave, Glenview, IL 60025. **See at Booth S5000** **Circle 258**

5M-byte, cartridge disk drive



Beta-5, a 5M-byte capacity 5¼″ disk drive, provides an ST506 compatible interface and conforms to industry standard 5¼″ form factor. The drive uses flying media recording, rotary voice coil actuator, and track following closed loop servo to supply high performance, reliability, and areal density. The flexible media stabilization method, based on Bernoulli technology, supplies high resistance to shock and vibrations. This technology also requires no air filtration systems and results in fast cartridge replacement. Seek time is cited as 5 ms min, 40 ms avg. The drive records 5M bytes/cartridge at 13,321 bytes/track and 256 bytes/sector. Data transfer rate is 5M bps. Recording is performed using MFM techniques at 17,373-bpi density. ***Iomega Corp***, 4646 S 1500 West, Ogden, UT 84403.
See at Booth D0330 **Circle 259**

5¼″ Winchester disk subsystems



V130, V150, and V170 offer 30.8M-, 51.4M-, and 72M-byte capacities, respectively, with 30-ms average access time (including settling). Reduced crosstalk and improved reliability over conventional open loop stepper systems is achieved by a dual-frequency closed loop servo that continuously samples and corrects head to track positioning as the disks rotate. This servo also eliminates temperature induced read errors common in open loop systems and is more tolerant of media defects on the servo surface. Potential shock and vibration damage are countered by an automatic actuator lock and dedicated landing zone, along with full shock mounting. During power-down, these features move and lock the drive heads over a nondata part of the disk and cushion the drives against jarring. The V130 accommodates 2 disks with 3 data surfaces; the V150, 3 disks with 5 data surfaces; and the V170, 4 disks with 7 surfaces. Data transfers occur at 5M bps over the ST 412/506 interface. Track density on all models is 960 tpi, and bit density, 9920 bpi. ***Vertex Peripherals Corp,*** 2150 Bering Dr, San Jose, CA 95131.
See at Booth W6582 **Circle 260**

NOTE: "A" series booths are located in Anaheim Convention Center's Arena, "N" series in the North Hall, "S" series in the South Hall, and "W" series in the Southwest Hall. "P" series booths are in the NCC Pavilions adjacent to the Registration area. "D" series booths are located in the Disneyland Hotel Convention Center. Shuttle buses will run between the two exhibit locations and all convention hotels.

Digi-Data Value Means:

FASTER DISK BACK-UP AT LOWER COST

Digi-Data's new Series 2000 Streamer will back-up your disk at up to 9.3M bytes per minute. It can record 1600 bpi densities at 125 ips, or 3200 bpi density at 62.5 ips. That means you can back-up 92M bytes on a single tape reel in under 10 minutes . . . including rewind. And the Series 2000 is ANSI/IBM compatible with start/stop speeds of 25 or 12.5 ips available.

We designed the Series 2000 for 3200 bpi from the start. Step-write . . . microprocessor controlled read electronics . . . and extended de-skew buffer are some of the unique Digi-Data features that make 3200 bpi operation more reliable. Check other streamers for comparable features.

The Series 2000 benefits from our 20 years experience in tape drive design. Microprocessor controlled calibration and power-up diagnostics are standard. Sensors are solid state and I/O lines are properly terminated. There are no loud vacuum blowers. And the number of moving parts has been minimized.

At 50 lbs and less than 19" depth, you won't find a smaller 1/2" streamer. Best of all, prices start at $1850. in large OEM quantities.

The Series 2000 is complemented by a full line of 1/2" and 1/4" tape drives for conventional start/stop operation.

See us at NCC Booth #S N4004-N4006

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CIRCLE 60



memory systems

Streaming tape transport

Fitting into a dual-floppy footprint, the low cost ½" IBM format compatible PCT-1000 provides both streaming and start/stop operation for applications including Winchester backup, data interchange, and archival data storage. It accommodates both 8½" (22-cm) and 7" (18-cm) diameter reels, as well as 10½" (27-cm) precision reels. An optional asynchronous interface is planned with internal data memory buffers for high speed DMA data transfers from host computer to drive. Standard Pertec/Cipher interface compatibility will be offered.



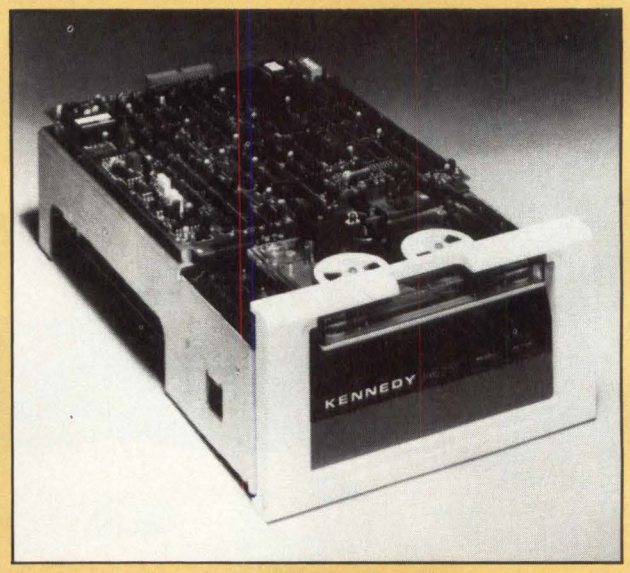
The unit is both IBM and ANSI compatible, recording 800-cpi (NRZI) and 1600-cpi (PE) formats. Switch-selectable dual-density 800/1600-cpi models will also be available. Tape velocity is 100 ips in streaming mode and 25 ips in start/stop mode. The traditional swing arms and a number of electromechanical components have been replaced through the application of microcomputer technology. Switcher (duty cycle modulation) driver electronics, and proprietary low profile reel motors contribute to low cost. Tape storage buffers and capstan motors have been eliminated through the application of realtime multitasking digital servo control software and hardware. ***Ibex Computer Corp,*** 20741 Marilla St, Chatsworth, CA 91311.

See at Booth D2110 **Circle 261**

7-track tape cartridge transport

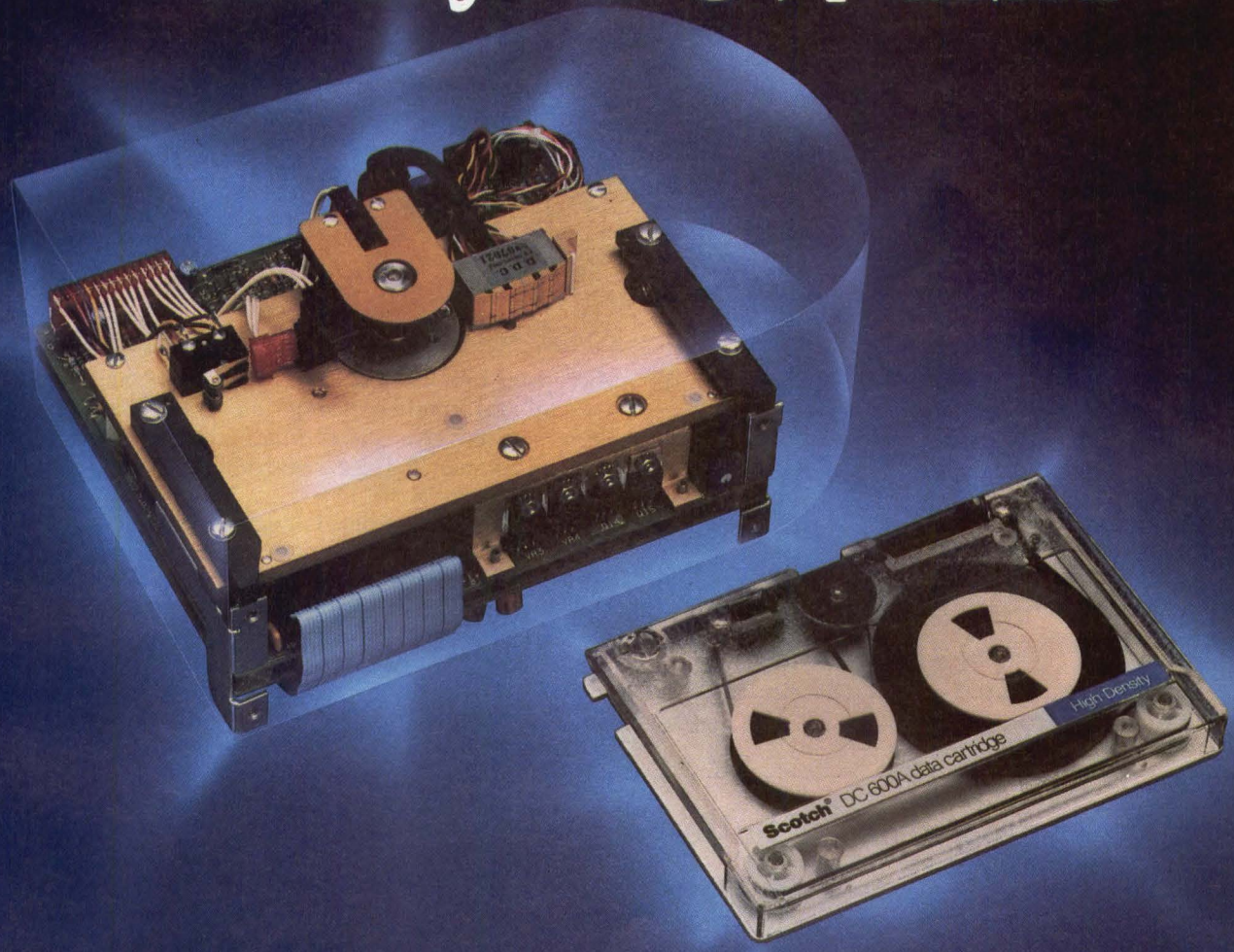
Using fixed heads to reduce mechanical complexity while improving read/write data reliability, model 6470 has a formatted capacity of 40M bytes with 450'(137-m) tape length cartridges or 50M bytes with 600' (183 m). An internal diagnostic technique allows tape ramp and speed adjustment in the field without an oscilloscope. Designed to back up 8" and 5¼" Winchester disk drives, the transport, in start/stop mode, permits data and file management procedures while storing and restoring disk data. For mirror backup, it establishes gaps on the fly while streaming. Time to transfer 40M bytes is 18 min.

The unit's 7 read/write tracks are fabricated into a single head. Because the heads are fixed, no stepping mechanism is needed; this reduces complexity while maintaining factory set head alignment. Individual head spacing is arranged so that tracks from a 6455 cartridge fall under alternate heads; this allows media interchange between 4- and 7-track transports. A selective erase function permits editing prerecorded records without affecting adjacent blocks or tracks. The transport uses self-clocking group code recording with a 10k-bpi recording density and 375k-bps



data transfer rate. Writing/reading speeds are 37.5 ips; rewind occurs at 90 ips. The embedded Picobus® formatter is compatible with model 6455 cartridge transport and model 7300 8" Winchester disk drives. ***Kennedy Co,*** 1600 Shamrock Ave, Monrovia, CA 91016. **See at Booth N3616** **Circle 262**

Digi-Data puts 30 Mbytes of disk backup in less space than your 5¼" disk.



Digi-Data Corporation proudly introduces the industry's first full-function ¼" cartridge tape drives to fit within a 5¼" disk footprint. Small in size (3.25 × 5.75 × 6.90"), but large in performance, these drives provide up to 300% more storage capacity than other available start/stop or streaming drives. Their 30 Mbytes of unformatted capacity will handle the backup requirements for most 5¼" and 8" Winchesters using a single cartridge.

Both start/stop and streaming modes give the OEM system designer flexibility not found in ordinary drives. Used in start/stop mode for on-line transactional backup or selective data-base editing, the drive will store 25.1 Mbytes of formatted data in under 15 minutes. Streaming mode storage of 29.5 formatted Mbytes can be achieved in less than 12.8 minutes.

Standard or serpentine head configurations, and industry standard I/O, as well as small size and dual-mode operation, make it easy to design these drives into your present or future systems.

ANSI and ECMA interchangeable media versions are also available, with somewhat lower storage capacity at 6400 BPI.

Digi-Data's commitment to high performance peripherals extends to its full line of ½" start/stop and streaming tape drives and subsystems as well, all offering the OEM user the best price/performance ratio in the industry.

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8580 Dorsey Run Road
Jessup, MD 20794
(301) 498-0200
TWX 710-867-9254

In Europe contact:
Digi-Data Ltd.
Kings House, 18 King Street
Maidenhead, Berkshire
England SL6 1EF
Tel. No. 0628 29555-6
Telex: 847720

CIRCLE 61

See us at NCC Booth #S N4004-N4006

memory systems

Half-inch magnetic tape drive

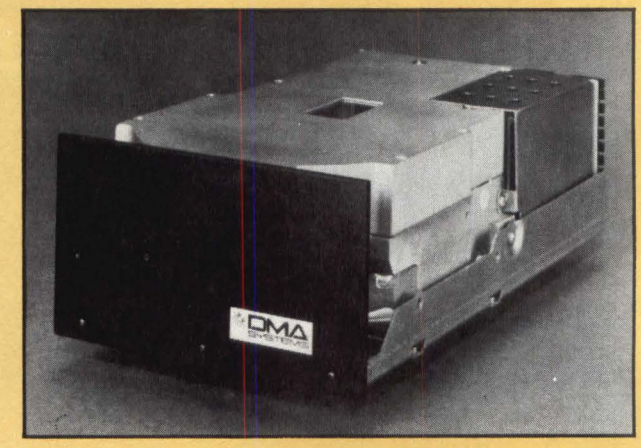
CacheTape M890 is a 75 ips ½" tape drive designed to back up 80M to 300M-byte Winchester disk drives. A 3200-bpi version provides 92M bytes of unformatted data storage on a standard reel of tape. The tape drive is fully software transparent with existing vacuum column and tension arm software. This compatibility extends to the physical interfaces. It is capable of dumping 31M bytes of phase-encoded data onto a tape reel in 15.7 min.

Functional capabilities of the tape drive include file-oriented disk backup, physical disk image backup, transactional journaling, tape merge/sort, tape interchange, data archiving, and data aquisition. ***Cipher Data Products Inc,*** PO Box 85170, San Diego, CA 92138.



See at Booth W6170 **Circle 263**

5¼" Winchester disk drives



Micro-Magnum 26F and 39F provide 26-M and 39M bytes of unformatted storage on fixed Winchester disks, respectively. These drives can be integrated with the company's fixed/removable drives to attain capacities up to 58.5M bytes.

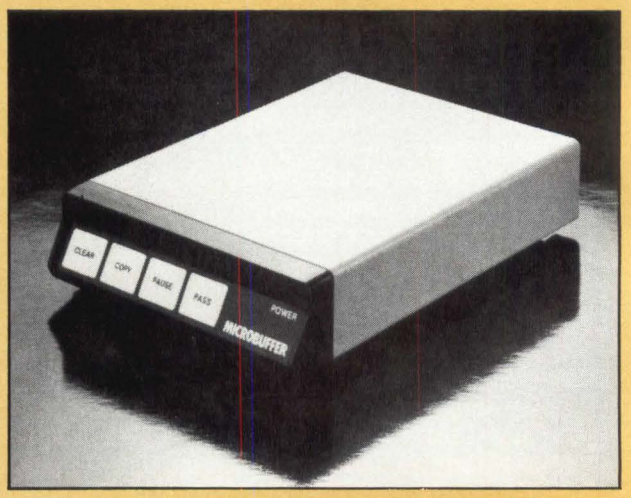
The capacity flexibility is due to embedded servo technology. Increasing the tracks per inch of embedded servo drives instead of increasing track density of dedicated servo drives provides higher capacity without decreasing the unit's reliability. Data integrity results from the use of proven technology. ***DMA Systems Corp,*** 601 Pine Ave, Goleta, CA 93117. **See at Booth D2444** **Circle 264**

Computer output memory buffer

The 32K Microbuffer In-Line provides memory buffer for a variety of output devices including serial or parallel printers, modems, typesetting equipment, word processors, plotters, and remote data entry. Sitting between the computer and output device, the system accepts data coming to or from the computer and holds them. Data are then transmitted to the output device at the proper speed. The serial version can be specified at 9 different baud rates from 75 to 19,200.

Copy feature allows up to 255 user-specified copies to be made without tying up the computer. Printing can also be halted at any time and continued as if no interruption had occurred. Additional data can be sent to the buffer any time during copying. The serial interface model includes a special PASS button that allows input data to pass around the buffer for log-on or setting up special output device parameters.

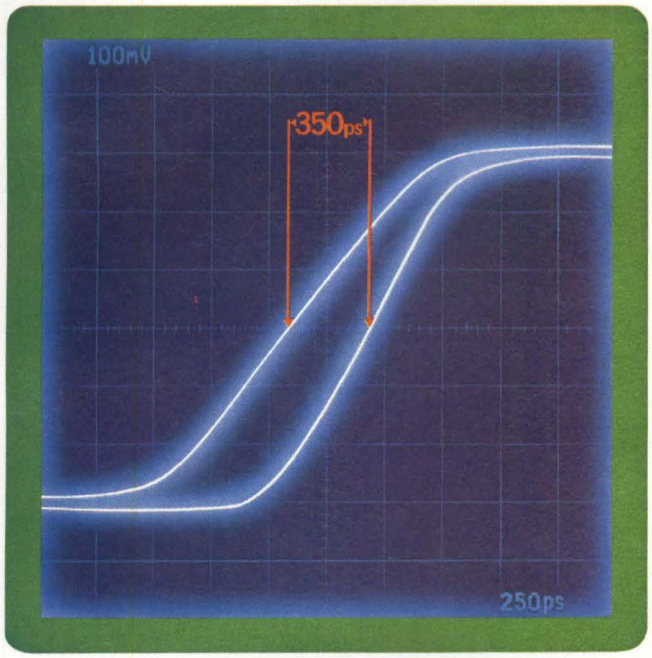
Compatible with any computer possessing any serial RS-232-C output device, the buffer requires no software modification. The buffer is available with 32K, 64K, or 256K of memory. Additional memory is available. ***Practical Peripherals, Inc,*** 31245 La Baya Dr, Westlake Village, CA 91362. **See at Booth D1200**

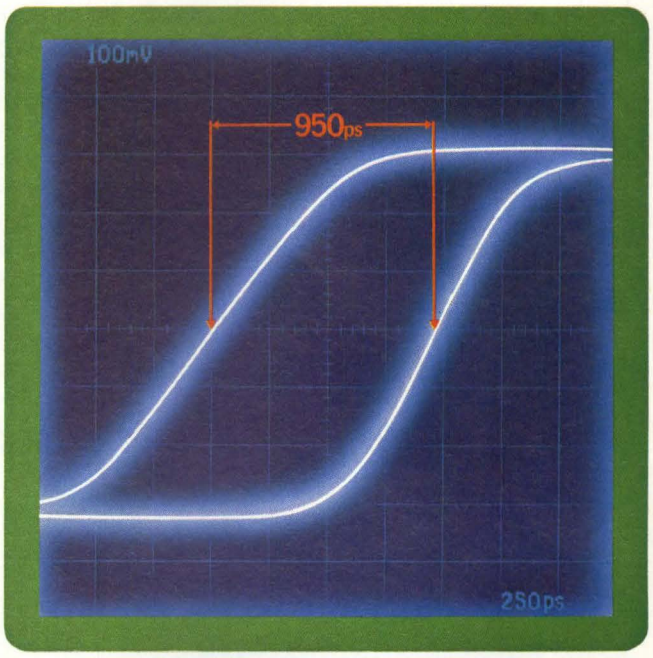


Circle 265

FAIRCHILD

A Schlumberger Company





GE2000: THE ARRAY OF OPTIONS.

The GE2000 high-performance ECL gate array gives you more speed and flexibility than any gate array you can buy. You control the performance. 350 ps gate delays for critical paths. 950 ps to conserve power. Or select a range of delays in between. All on the same chip!

With 2000 gates you can pack more of your system on fewer chips. And since no signal buffering is necessary, interface delays drop substantially as well. Combine this with a 500 MHz worst case toggle frequency and you'll have unbeatable performance.

There's more. ECL or TTL I/Os. 500 and 1000 gate versions. An extensive macro library. And an advanced CAD system to tie it all together.

Which all means if you need greater performance than any other gate array can offer, you suddenly have a whole lot of options. And they're all on the GE2000. Call or write Fairchild Gate Array Division, 1801 McCarthy Blvd., Milpitas, CA 95035, (408) 942-2672.

Gate Array

Fairchild Camera and Instrument Corporation

CIRCLE 62

ncc '83 product preview

memory systems

QIC-24 compatible tape drive

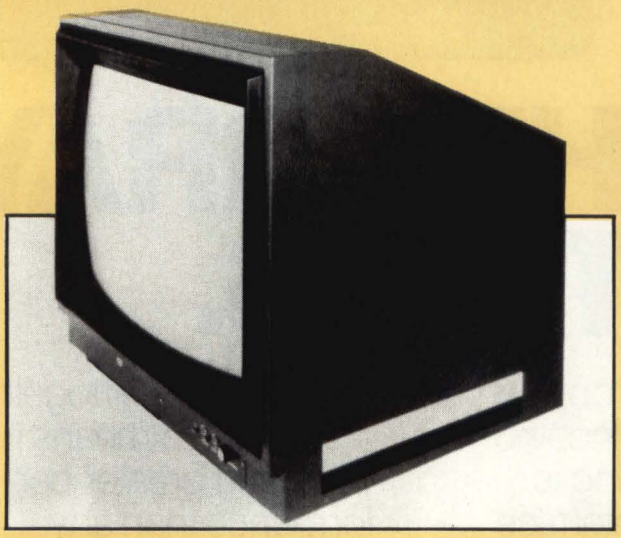
By providing for interchange of recording cartridges, the proposed QIC-24C standard extends flexibility as well as applicability of ¼" streaming tape cartridges. System 5000 now meets both QIC-02 and the proposed QIC-24C format. Standard QIC-24 covers 4- and 9-track recording formats, specifying a 4-byte address block, track reference burst on track 0 between BOT and load point, and definition and use of control blocks. With 45M-byte storage capacity and 90-ips tape speed, the transport fits flexible, high capacity Winchester backup into a 5¼" floppy disk drive space. *Wangtek,* 5845 Uplander Way, Culver City, CA 90230.



See at suite, Hilton at the Park **Circle 266**

peripherals

Raster-scan graphics displays



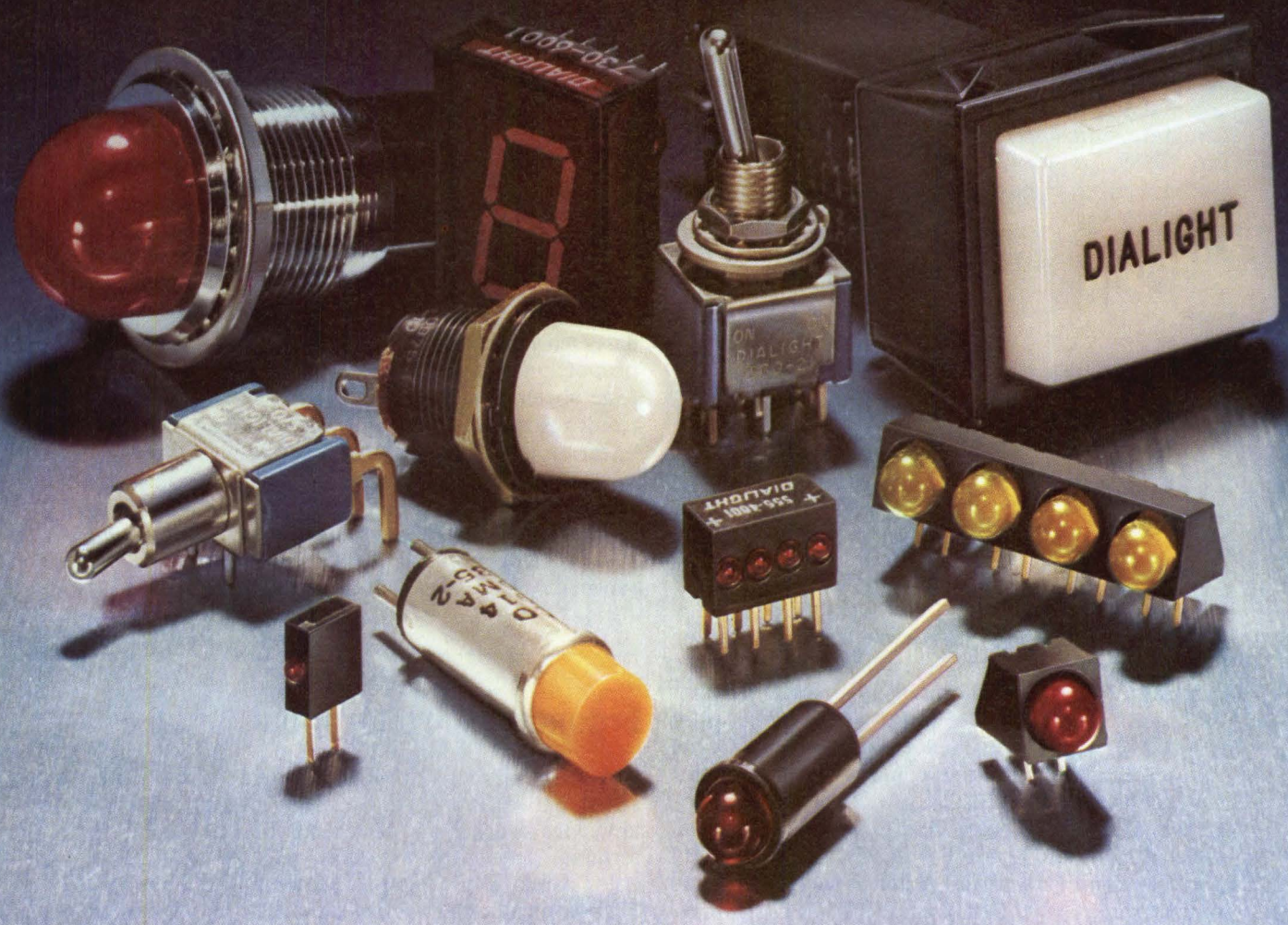
Color and monochrome CRT display units are available in diagonal sizes ranging from 5" to 25" (13 to 63 cm). HDM, CD, and UD series are intended for full color or monochrome displays; BDM series is designed for monochrome display only. HDM models feature ultra-fine resolution analog display units in 19" (48-cm) and 25" (63-cm) sizes for precise graphics. With a maximum of 1280 x 1024 pixels, these units gain precision by use of a delta-gun, raster-scan CRT along with analog video amps. Adjustable front-panel convergence controls ensure sharp color or monochrome graphics details. CD models offer high performance in both analog (CDA) and digital (CDB) models. These units incorporate in-line gun CRTs with a black matrix coating, providing a pixel range from 720 x 256 to 1024 x 1024. The CDA units feature analog video amps permitting an infinite range of color gradations.

High speed switching digital video amps are employed on CDB units, providing 27 distinct color variations (by means of a half brightness control for each RGB color). UD models are high performance, economical display units with in-line gun CRTs providing 615 x 240 pixels or more. All electronics are on a single circuit board. These units are digitally driven with up to 7 distinct, selectable colors available. BDM models are high-performance monochrome display units available in standard CRT sizes from 5" to 15" (13 to 38 cm). Eight models provide a pixel range of 500 x 208 to 1120 x 750. Units are available with either P39 (long-persistence green), P4 (white), or P31 (short-persistence green) phosphors. ***Ikegami Electronics (U.S.A.), Inc***, 37 Brook Ave, Maywood, NJ 07607. **See at Booth D2300** **Circle 267**

Intelligent plotters

Line of X-Y plotters in flatbed or roll takeup models offers 1-, 2-, 6-, and 10-pen versions with ink, fiber, or ballpoint tips. Multipen models feature automatic magnetized pen changeover. Maximum plotting speed for all models is 400 mm/s over a 10" x 15" (25- x 38-cm) plotting surface. Programmable function commands draw straight lines, characters, symbols, curves, and circles. ***Watanabe Instruments Corp,*** 3186-D Airway Ave, Costa Mesa, CA 92626. **See at Booth D1801** **Circle 268**

Dialight adds the finishing touch.



High quality and reliable performance make Dialight switches, indicators, LEDs and readouts the perfect finishing touch for any product.

We have rockers, toggles and illuminated switches in thousands of different designs. And our incandescent, neon and LED indicators and opto-electronics come in the world's largest selection of colors, shapes and sizes.

Whatever your requirements, Dialight can meet your needs. Let us add the finishing touch that helps your products make a great first impression. Dialight, 203 Harrison Place, Brooklyn, NY 11237 (212) 497-7600.

DIALIGHT
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Circle 63 indicator lights Circle 64 switches Circle 65 optoelectronics Circle 66 to have representative call

peripherals

High resolution printer/plotter

Model 4160 prints at 130 1pm. Small dot size combined with large dot overlap provides high resolution graphics and facsimile printing on plain paper. As a plotter, plot density is 160 dots/in, plot width is up to 13.6″ (35 cm), and maximum plot speed is nominally 13.6 ips. A complex 8.5″ x 11″ (22- x 83-cm) A-size drawing is plotted in 40 to 50 s. Dot diameter is 0.010″ (0.025 cm). As a bar code label printer, the unit prints Code 3 of 9 chars at a density of 7.5 cpi nominal and interleaves 2 of 5 Code chars at 10 cpi nominal. ***Printronix, Inc***, 17500 Cartwright Rd, PO Box 19559, Irvine, CA 92713.



See at Booth W6188 **Circle 269**

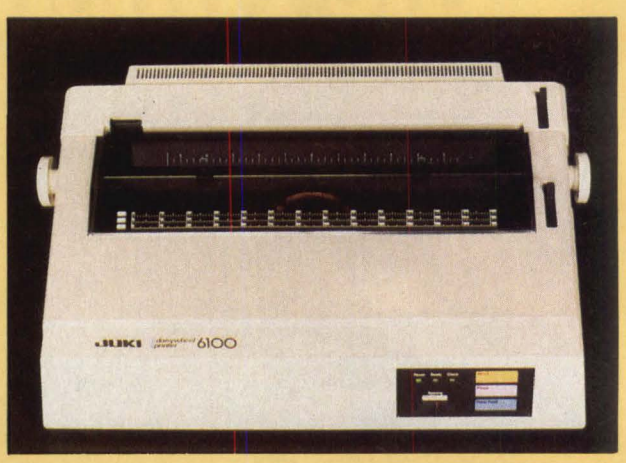
200 cps matrix printers

Providing continuous duty cycle reliability along with personal computer system compatibility, 3000 PC series printers provide high resolution print quality. Models 3020, 3014, and 3024 output draft quality print at 200, 160, and 200 cps, respectively, using a 9-wire printhead. Single-pass memo mode on models 3014 and 3024 prints at 80 and 100 cps; 2-pass letter mode outputs at 40 and 50 cps. Graphics resolution of all models is 60 or 72 x 72 dots/in. Interface is RS-232/CCITT and Centronics parallel, switch selectable. Serial transfer rate is 9600 baud; parallel is 1k cps. Forms up to 14″ (36 cm) long and widths from 3.2″ to 15.5″ (8.1 to 39.4 cm) are accommodated. Character set is composed of 96-ASCII, 40-national, and 64-graphic characters. ***General Electric Co, Data Communications Products***, GE Dr, Waynesboro, CA 22980.



See at Booth S5018 **Circle 270**

18-cps daisy wheel printer



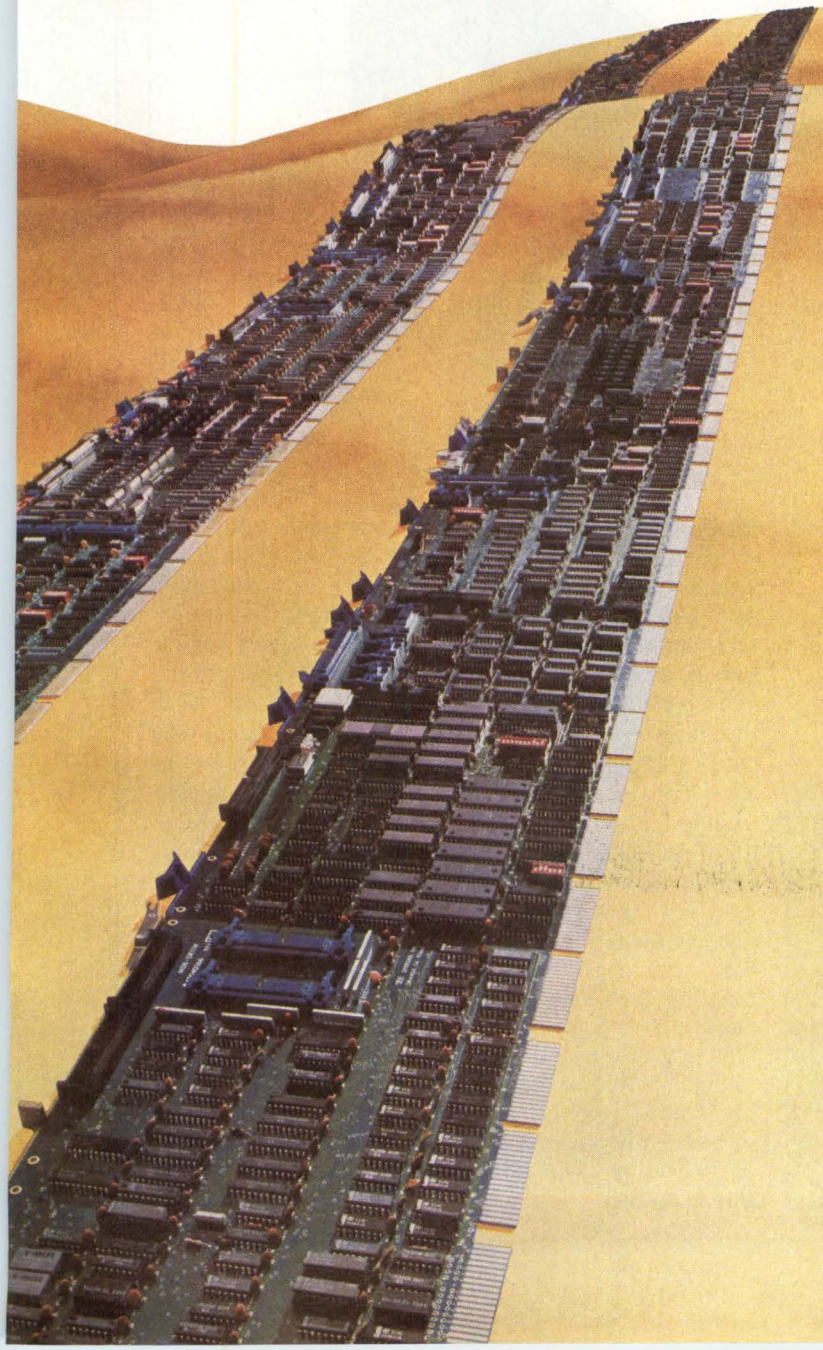
Model 6100, a letter quality printer, has both graphic mode and word processing functions. Using a 100-char daisy wheel and 13″ (33 cm) platen, the unit provides proportional spacing as well as 10, 12, or 15 pitch. Line spacing is 0.02″ (0.05 cm). Interface is Centronics parallel; RS-232-C serial is optional. The unit's linear motor consumes only 40 W idling; an average of 80 W running. A 2k-byte buffer is standard; this expands to 8k bytes. Bidirectional or unidirectional tractor and cut sheet feeder are options. ***Juki Industries of America, Inc***, 20437 S Western Ave, Torrance, CA 90501. **See at Booth W6278** **Circle 271**

Ergonomic APL terminal

TDV 2221 produces 72 overstrike characters and alternates between APL and ASCII modes from the keyboard and the host computer. In ASCII mode, the terminal acts as an advanced teletypewriter. Two-color keytops distinguish between APL and ASCII keyboard characters. Software structure, use of non-volatile EAROM for operational mode commands, and an additional plug-in memory board make it possible to combine several emulator characteristics in 1 terminal. For instance, the TDV 2271 is a combination of TDV 2221 (APL/ASCII) and TDV 2230 (VT100/VT52).

Other 2200 series terminals emulate IBM 3101 and DG 6053/D200 displays. All meet the 1985 German Ergonomic Standard, achieving optimal relationship between light output from CRT and workstation elements under all lighting conditions. Anti-reflex tube with tilt/swivel mechanism greatly reduces reflection, and 15″ (38-cm) screen with 0.175″ (0.445-cm) characters aids readability. ***Tandberg Data, Inc,*** PO Box 99, Labriola Ct, Armonk, NY 10504. **See at Booth P7318** **Circle 272**

The rumor is true.



Only one company under the sun makes every type of peripheral controller for DEC* Computers.

See them all together for the first time at the N.C.C.
Booth #'s W6017, W6019, W6021, W6023

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Circle **67** for LSI-11 Circle **68** for PDP-11

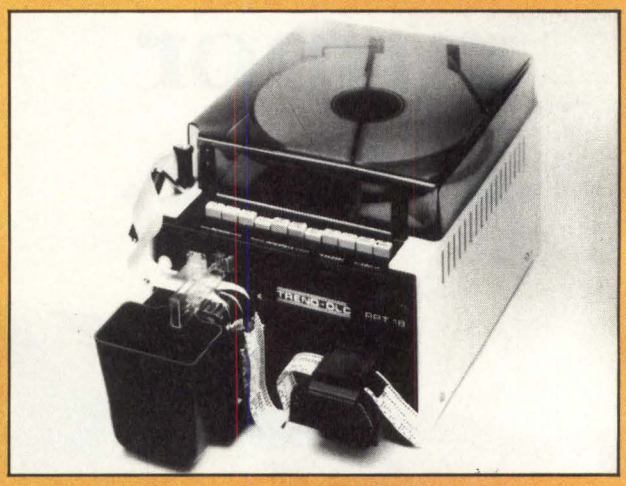
peripherals

Tape punch/reader terminals

Designed for numerical control and telecommunication applications, 30- and 60-cps punch, read, and editing systems accept ASCII, EIA (NC), and Baudot codes, and convert ASCII to Baudot, Baudot to ASCII, ASCII to EIA, and EIA to ASCII. Terminals offer selectable baud rates; up to 4 ports/unit (RS-232 and parallel); and current loop, 4k buffer, and answerback options.

Both 60-cps RPT-648 and 30-cps RPT-48 microprocessor based intelligent tape preparation and editing systems prepare, modify, and provide for communication of NC program tapes. Formatting features perform automatic line and block numbering, resequencing, arithmetic tape modifications, and human-readables. Both systems operate with a CRT and receive-only printer to facilitate editing and provide permanent hard copy.

In addition, RPT-18 tabletop paper/mylar tape reader and punch terminal comes with ASCII to NC or ASCII to Baudot code conversion capabilities. It can



connect to a keyboard send/receive printer to provide automatic send/receive capabilities, or be used standalone. The unit punches and reads fanfold tape and senses low tape supply and tight tape. ***Trend-DLC, Inc,*** 280 Midland Ave, Saddle Brook, NJ 07662. **See at Booth N4307** **Circle 273**

Quiet-running thermal printer

Priced low for use as a low end personal computer peripheral, STX-80's features include both bit image and block graphics, European characters, and bi-directional logic seeking printing of 80 chars/line (40 chars/line in expanded print mode) at 60 cps. The thermal printing mechanism uses standard 8½″ wide friction feed thermal roll paper. The paper infeed roll of up to 100′ (30.5 m) fits within the case. Printer has 96 standard ASCII characters, 51 European characters, and 64 (Videotex-format) block graphic characters. Standard characters are printed using a 5 x 9 dot matrix and 0.17″ (0.43-cm) line feed; block graphic characters use a 6 x 6 dot matrix and 0.17″ line feed; bit image graphics use an 8 x 480 dot matrix and 0.12″ (0.30-cm) line feed. Front panel controls, in addition to power switch and pilot light, include switch, status lamp, and line-feed switch. Printhead life is an expected 20M chars; printer life exclusive of printhead is 5M lines. A Centronics-type 8-bit parallel interface is standard. The unit responds to standard computer commands for carriage return, line feed, form feed, horizontal tab, mode selection, and toggling expanded printing. An onboard DIP switch bank allows users to select options that include 11″ (28 cm), 66-line form length [standard is 12″ (30 cm), 72 lines]; no line feed on carriage return (automatic line feed is std); 8-bit printing (7-bit standard); and optional European characters. ***Star Micronics, Inc,*** 1120 Empire Central Pl, Dallas, TX 75247. **See at Booth D2243** **Circle 274**



The World's Most Elegant Microprocessor Family is Here. Now.

NS16000

Elegance is everything.

No more band-aids to stretch an architecture.

The NS16000 features a totally new, totally practical architecture—not simply an enhancement of an existing one. With supporting National and third-party software, the NS16000 microprocessor family becomes the first to offer system designers the opportunity to adopt the migration path and performance of a full 32-bit architecture that will endure to the end of the century. That's elegance.

No more programming in novel ways for obscure reasons.

Only the NS16000 microprocessor family's architecture is deliberately based on high level languages, intentionally designed to support their use. The architecture's structure and behavior correspond directly to the objects and operations of HLLs—enabling symmetric use of general-purpose registers, memory locations, expanded addressing modes, data types, and sophisticated instructions. The disadvantages of writing programs in HLLs for microprocessor-based systems have now been elegantly relegated to computer history.

No more dead-end segmentation.

The NS16000 is the first commercial microprocessor to solve the problems of large memory management by using both uniform addressing and Demand Paged Virtual Memory. With this memory strategy —equivalent to that used in the VAX™-11 and all present IBM mainframe computers—each programmer, each program, each task, can simultaneously and independently access a uniform addressing space of 16 megabytes, without reservation or special exception. That's elegance.

Think about it.

The New Criterion in Software Productivity:

The NS16000 Microprocessor Family.

The pure migration path and the virtuoso performance inherent in the NS16000 microprocessor family are just the beginning.

The NS16032 CPU, now available, has a 16-bit-wide data path to memory and 32-bit architecture. Other CPUs in the family will feature 8- and 32-bit-wide data paths, but the 32-bit implementation in each ensures that the software you write today will work *without modification* tomorrow, when you upgrade from one CPU to the next.

Evaluating performance: a 32-bit integer multiply on the NS16032 CPU takes only 8.3μs at 10MHz.

The architecture of the NS16000 family is based on the roots of all the most powerful high level languages—to fully support the use of HLLs.

Programmers have long asked for a microprocessor designed with the software in mind. The regularity of the architecture for which code is being generated significantly affects its quality: the more regular the architecture, the simpler it is to produce lean, fast code. And, of course, designers and programmers write programs more quickly in high level languages.

The CPUs in the NS16000 family provide a high degree of regularity in the arrangement and use of their 32-bit registers. Data can be read or written 1, 8, 16, or 32 bits at a time, as a sophisticated program requires. Transfers from one register to another are not restricted: no special conditions inhibit a programmer's creativity.

The virtuosity of the NS16000 instruction set is clear. It includes over 100 basic instruction types, chosen on the basis of the use and frequency of specific instructions in various applications. Special-case instructions, which compilers cannot use, have been avoided.

The instruction set is also symmetrical: instructions can be used with any addressing mode, any operand length (byte, word, and double-word), and can use any general-purpose register. Instructions are *genuine* two-operand instructions as well.

These factors, combined with the regularity of the NS16000's architecture, mean that programs require significantly less code—greater code density, in fact, than the VAX-11. The simplicity by which it now becomes possible to implement a compiler, for example, is matched only by the increased speed of its execution.

The NS16000 family provides the largest number of different addressing modes ever included in a microprocessor.

Elegant programming demands that instructions be as powerful as possible, and that the range of addresses be as large as possible. So to be effective, a powerful instruction set must be accompanied by a powerful set of modes of referring to data in registers and memory.

The NS16000 architecture supports not only the standard addressing modes common to most processors (*register, immediate, absolute,* and *register relative,* for example), it also introduces HLL-oriented modes unique to microprocessors:

1. Top-of-stack (a simple, very powerful mode used to evaluate arithmetic expression in HLL);
2. Scaled Indexing (used to access elements in byte, word, double-word, or quad-word arrays);
3. Memory Relative (used for manipulating fields in a record); and,
4. External (used to access data in separately compiled modules).

Moreover, there are no restrictions on the use of these addressing modes —an instruction that operates on data of a particular kind can use any of the addressing modes that refer to that data.

With an architecture that supports uniform addressing, the NS16000's Demand Paged Virtual Memory strategy makes a gigantic memory possible at a minimum cost.

The NS16082 Memory Management Unit (MMU), provides dynamic address translation, virtual memory management, memory protection, and both hardware and software debugging support. Customers now sampling this MMU are impressed with its raw power.

The NS16082 breaks the logical address space into 32,768 pages, each with a fixed size of 512 bytes. Which specific 512-byte pages of a program or data are actually in *real* memory is a function of the most recent demands of the program itself.

This Demand Paged Virtual Memory operates automatically, and gives an applications programmer complete freedom from any consideration of memory size or allocation strategy. Since the operating system places part of the user's programs and data in peripheral storage and brings them into real memory only as needed, the user may regard the combination of real and peripheral storage as a single, large memory, and can write large programs without worrying about the physical memory limitations of the system.

The power of Demand Paged Virtual Memory allows any number of separate and independent programs or tasks to execute cooperatively and efficiently in a substantially smaller (real) memory configuration than needed by a microprocessor using a *segmented* memory management scheme.

And, because it does not limit data base growth, Demand Paged Virtual Memory provides for continuing future data expansion.

VAX, VMS, and RSX are trademarks of Digital Equipment Corporation.
UNIX is a registered trademark of Bell Laboratories.
CP/M is a registered trademark of Digital Research.
NSX-16, ISE/16, and Starplex II are trademarks of National Semiconductor Corporation.

Floating point is just one of the nine data types that the NS16000 architecture directly supports.

The NS16081 Floating Point Unit (FPU) offers very high-speed floating-point operations for both single- and double-precision operands. A 32-bit floating-point multiply, for instance, takes place in 4.8μs at 10MHz.

Designing the NS16081 into a system will allow programmers to treat floating-point numbers as any other data types, and any of the addressing modes may be used to reference them. Customers now sampling this FPU are amazed at its performance.

The optional use of the FPU and MMU Slave processors—integral parts of the NS16000's architecture—gives the systems designer the ability to determine a price/performance trade-off while preserving all the initial software investment.

Evaluation tools are available now.

The DB16000 evaluation board is a complete microcomputer system. It carries the NS16032 CPU, the NS16201 Timing Control Unit, sockets for the MMU, FPU, and ICU (Interrupt Control Unit), 32K bytes of on-board RAM, a wide range of both standard and optional I/O interface devices, and a monitor program in PROM. To allow interfacing with a variety of computer systems, a complete pin-out of CPU addresses and functions for data and control are also included. Two BLX connectors enable functional enhancements.

A component evaluation kit (the NS160KIT) is also available, with complete documentation for each part.

The first products in a line of development tools—the NSX-16,™ with a PASCAL compiler, and the ISE/16™—are available now.

The NSX-16 software development package allows quick and easy compiling or assembly of NS16000 programs on the VAX-11, using the VMS™ operating system. The package includes a PASCAL compiler, assembler, linker, librarian, symbolic debugger, and other utilities. Once compiled, programs can be down-loaded through a serial data link to the DB16000 for execution. (A NSX-16 hosted on RSX™-11M, and a C cross-compiler for VAX will be available by mid-year. Before the end of this year, a full NS16032-based development system, with a UNIX® operating system and a choice of either a C or PASCAL compiler, will also be available.)

The ISE/16 In-System Emulator—the first in a series—is available to ease integration of user software with NS16000 hardware. It runs with the NSX-16 software development package, and allows real-time emulation of the NS16032 CPU, the NS16201 Timing Control Unit, and the NS16082 Memory Management Unit.

The availability of third-party software for the NS16000 family is growing day by day.

Suppliers are now working on operating systems (UNIX, for example), language compilers (such as PASCAL, C, and COBOL), and software for program development (among them, on CP/M®).

Training classes are in progress now.

Courses lasting from two to five days—held either at the Microprocessor Systems Division Training Center, or on-site—cover "The NS16000 Architecture," "NSX-16 Software Development Support on Starplex II™ or VAX," and "ISE/16."

Now you have every reason to explore elegant applications using the NS16000 microprocessor family—from personal computers, to graphics systems, to process control.

NS16000

Elegance is everything.

Talk with us.

Please call the National sales representative nearest you for more information, and the answers to your questions. Or, circle the number below.

See it.

The NS16000 microprocessor family will be on exhibition at NCC (look for booth number D-2022).

Read about it.

Introduction to the NS16000 Architecture

CIRCLE 69

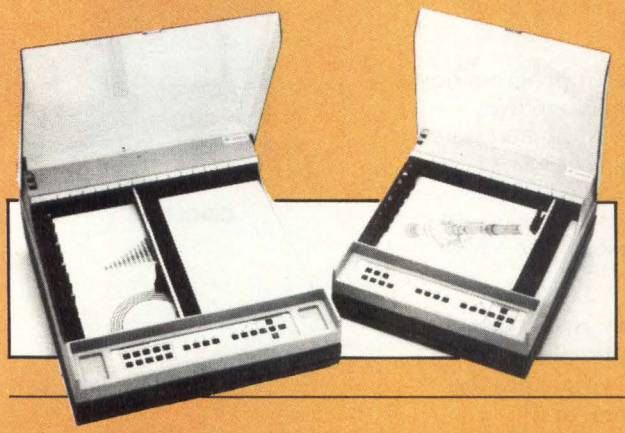
National Semiconductor

MICROCOMPUTER SYSTEMS DIVISION

peripherals

Multicolor graphics plotters

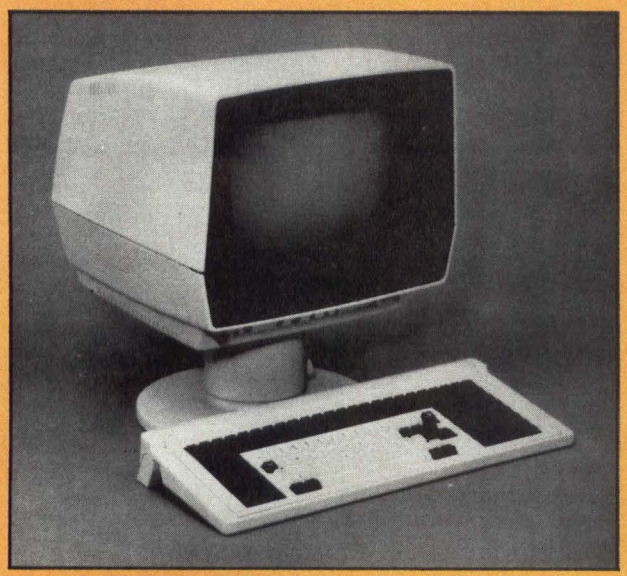
Computagraph Colorwriter produces publication quality graphics with virtually any computer or microprocessor based system. Sophisticated onboard software offers performance and requires little or no prior programming experience to operate. Connecting to computer or time share terminal via interchangeable RS-232-C and IEEE 488 interfaces, the plotter offers language flexibility to match. This includes the company's powerful graphics language, emulation of H-P Graphics Language, and the ability to accommodate added graphics standards with interchangeable PROMS. The unit is available in either A3 11″ x 17″ (28- x 43-cm) chart format size with 10 pens, or A4 8½″ x 11″ (22- x 28-cm) chart format with 7 pens.



For unattended plotting, an optional roll chart advance is also provided. To simplify hardcopy graphics production, built-in intelligence and special graphics features allow sophisticated graphics to be produced by noncomputer specialists. Five different character sets, including upper and lower case, full drafting quality, and European accents, are stored in ROM and are called up with simple instructions. Other features include variable line fonts, cross-hatching, bar and pie charts, arc and circle generation, character rotation and slant, and zooming and windowing facilities. Characters can be rotated and slanted in better than 1° steps and comprehensive self-checking routines are built in.

The unit has a 5-cps print speed and accelerates with a writing speed of 40 cm/s, or 55 cm/s with the pen up. To minimize computer time needed to generate complex plots, buffer memory allows the host computer to transfer all plotting data at one time. The standard 2K memory is expandable up to 16K and permits an addressable resolution of 0.025 mm to ensure step-free graphics. Full digitizing allows the plotter to become a graphics tablet with the addition of an optional digitizing sight. Thus, accurate coordinates for positioning and plotting standard shapes can be fed back to the computer, and existing drawings can be digitized for storage. Other user-oriented features are self-checking facility, accessible touch controls with positive tactile feedback, and electrostatic paper holddown. ***Gould Inc, Instruments Div,*** 3631 Perkins Ave, Cleveland, OH 44114. **See at Booth W6058** **Circle 275**

Distributed processing terminals



See at Booth S5083 **Circle 276**

Series 8000 CRT terminals are available in a standalone version (model 8188) and support a printer, disk, and other peripherals as well as a cluster terminal (model 8178) designed for attachment to the 8714 controller. The terminal controller uses Multibus-compatible modules to support up to 32 terminals over a 1M-bps twinax link. Both terminals and controllers are based on the 16-bit 68000 microprocessor. Operating systems include UniPlus, with realtime enhancements, and RM/COBOL, Pascal, BASIC, and FORTRAN languages. With a cable-through approach, up to 8 terminals per line and 4 lines per controller are possible. Cabling is kept to a minimum.

Terminals can be located over 2000′ (607 m) from the controller. A more conventional version is available with an RS-232 cluster interface supporting up to 32 display or print devices. All models use a multidiscipline communication controller chip, supporting a variety of bit- and byte-oriented protocols as well as 2 host communication channels at rates up to 56k baud. The controller also has a provision for **Winchester and/or floppy disk.** ***Megadata Corp,*** 35 Orville Dr, Bohemia, NY 11716.

Make your low-power ideas fly with Zilog's new Z80L. Full Z80® performance at only 15 ma.



If you've been itching to put the power of the Z80 CPU to work in portable equipment, battery-powered equipment or any other application in which power supply constraints make a difference, you don't have to wait anymore. Zilog's new Z80L runs at just 15 ma, one-tenth the power of the standard Z80.

You get all the features that have made the Z80 CPU famous including the full 158 instruction set. The Z80L is totally hardware and software compatible with the Z80. In fact, any program you are presently running on a Z80 will run without modification on the Z80L at clock speeds from 1.0 MHz to 2.5 MHz.

This breakthrough is made possible by a unique and highly sophisticated Zilog NMOS process that makes it possible for Zilog engineers to put more performance into a Zilog NMOS chip than other manufacturers can achieve with costly CMOS processes. You benefit from NMOS reliability, high performance, reduced parts count, and off-the-shelf availability today.

And, the Z80L now has a complete family of low-power peripherals: PIO, CTC, SIO and DART. Combined with the Z80L, they help keep your systems cost down while performance stays up.

To find out more, call Zilog TOLL FREE 800-272-6560. Or mail the coupon to: Zilog, Inc., Components Tech. Publishing, 1315 Dell Avenue, Campbell, CA 95008.

☐ I'd like more information at this time.
☐ Please have a salesman contact me.

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Title _____

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Z80L CD 5/83

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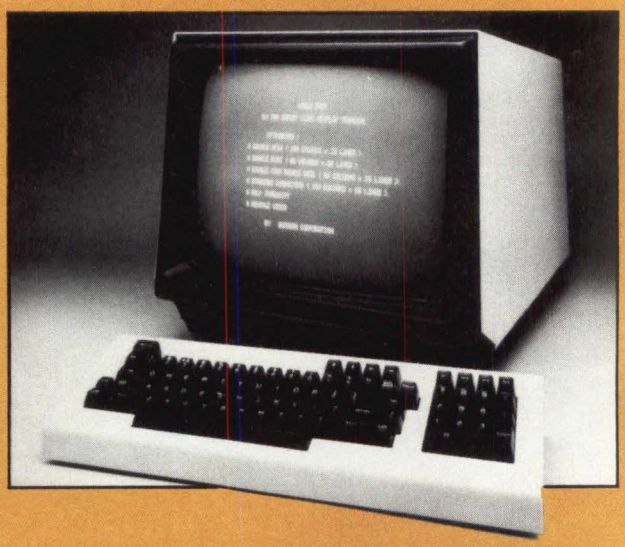
Microcomputer matrix printer

Microprism features Maisy printing technique, which yields bold, fully formed characters at 75 cps in a single pass of the printhead. For high speed printouts, data mode provides 110 cps. DotPlot graphics, standard on every unit, has high single pass density. Fully formed characters result from staggered needles that allow overlapping dots. This provides high resolution raster graphics, programmable character densities, and enhanced mode. The unit supplies proportional and fixed spacing, auto text justification, backspace and overstrike capability, vertical and horizontal tabbing, and high speed 110-cps data mode. Operator controls include online/offline switch, power indicator, fault and paper-out indicator, and DIP switch for setting power-up parameters. DIP switch selects either parallel or serial interface. Serial rates include 9600, 1200, and 300 baud; X-ON/X-OFF protocol and DTR are included. Graphics mode provides 84 x 84 dots/in resolution in a single pass. Capable of generating a variety of characters, graphs and drawings, it is bit mapped for maximum output control. ***Integral Data Systems***, Milford, NH 03055. **See at Booth A3101** **Circle 277**

High speed nonimpact printer

ND3 operates with a laser beam character generator and an electrophotographic printing facility. On single-part continuous fanfold stationery, the unit prints between 5250 and 21,000 lpm (at between 6 and 24 lpi). Maximum printing performance results from form paper speed of 14.58 in/s (0.37 m/s). Speed is not affected by line length, number of lines, line density, character density, or the total number of characters printed. Nonstop printing rate is 103 pages of 8½" depth/min. Two versions differ in resolution. The high resolution version uses characters made up of 24 x 40 dots. Data transfer, printing system functions, and diagnostics are controlled by integrated microprocessor based control electronics. Each write command enters 1 print line into the page buffer. When sufficient information has been transferred to form a complete output page, the actual print operation is performed independently of the CPU. A low paper condition, the occurrence of an invalid character in the page buffer, and other device status indicators are reported to the CPU by means of status and sense bytes. ***Siemens Corp, OEM Data Products Div***, 240 E Palais Rd, Anaheim, CA 92805. **See at Booth W6458** **Circle 278**

Full-page display terminal



Screen area of the Omega Data X7 allows entire accounting spread sheets or both pages of a 2-page business letter to be seen at once. Typical computer printouts can be displayed full width. The 17" (43-cm) CRT has capacity for 10,560 chars in an area 160 char wide x 166 lines deep; in split screen, 2 separate 80-char x 166-line displays appear simultaneously. Split screen mode allows the last 2 pages of information to always remain on the screen. When data are added, information scrolls from left split screen to right split screen. The terminal is DEC VT-100 and ANSI compatible. It has 96 ASCII u/lc characters with descenders, plus 32 standard graphics symbols. Any combination of characters can be displayed with any combination of attributes—blink, half-intensity, reverse video, double high, double wide, and double high/double wide. Graphics option includes PLOT-10 commands with standard resolution of 480 horizontal x 264 vertical. RS-232-C communications interface is standard; Centronics parallel port is optional. Ten transmission rates from 75 to 19.2k bps are keyboard programmable. ***Quadram Corp,*** 4357 Park Dr, Norcross, GA 30093. **See at Booth D1050** **Circle 279**

NOTE: "A" series booths are located in Anaheim Convention Center's Arena, "N" series in the North Hall, "S" series in the South Hall, and "W" series in the Southwest Hall. "P" series booths are in the NCC Pavilions adjacent to the Registration area. "D" series booths are located in the Disneyland Hotel Convention Center. Shuttle buses will run between the two exhibit locations and all convention hotels.

PRIAM

Discover the performance advantages of PRIAM 8-inch Winchesters for multi-user/multitasking applications—from word processing to database management to local area networking.

A Complete Line Of 8-inch Winchesters. Take your choice. Capacities? 35, 70 and 105 Mbytes. Interfaces? PRIAM, ANSI, SMD or PRIAM's intelligent interfaces—the SMART-series. And our 8-inch Winchesters share a common form factor with industry-standard 8-inch floppy drives.

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PRIAM Corporation, 20 West Montague Expressway, San Jose, CA 95134, Tel: (408) 946-4600, TWX: 910 338 0293, FAX: 408 946 5679. Los Angeles (714) 680-5195, Minneapolis (612) 854-3900, Boston (617) 890-8920, New York (201) 542-8778, Reading, England UK-734-884788.

CIRCLE 70

Come see us at NCC booth number N4808

It isn't just plug-compatible, it's software-compatible.

Introducing AMS 315, the first Winchester precisely designed to the storage specifications of 300-MB removable pack drives. So for the first time you get all the advantages of a 300-MB Winchester without rewriting your software. Or redesigning your interface.

We're truly SMD compatible.

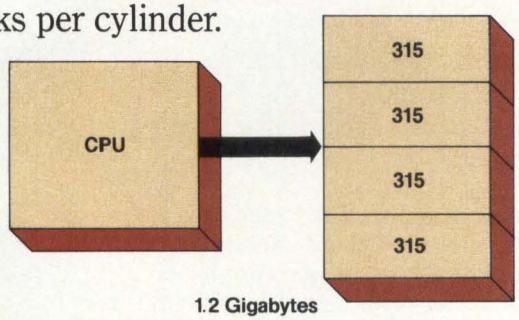
Century's AMS 315 has the same 20,160 bytes per track.

Same 19 tracks per cylinder.

Same 823 cylinders per spindle.

Same 3,600 RPM rotation.

All in one-third the space. Using less than half the power.



Stack four AMS 315s for 1.2 gigabytes of Winchester storage in about the same space as your 300-MB removable pack drive.

At about two-thirds the initial delivered cost.

Plus you get more than twice the reliability and eliminate preventive maintenance so the on-going cost of ownership is less, too.

Expand your mass storage alternatives with Winchester technology. You'll see the difference right away. Your system never will.

Call to arrange a test drive.

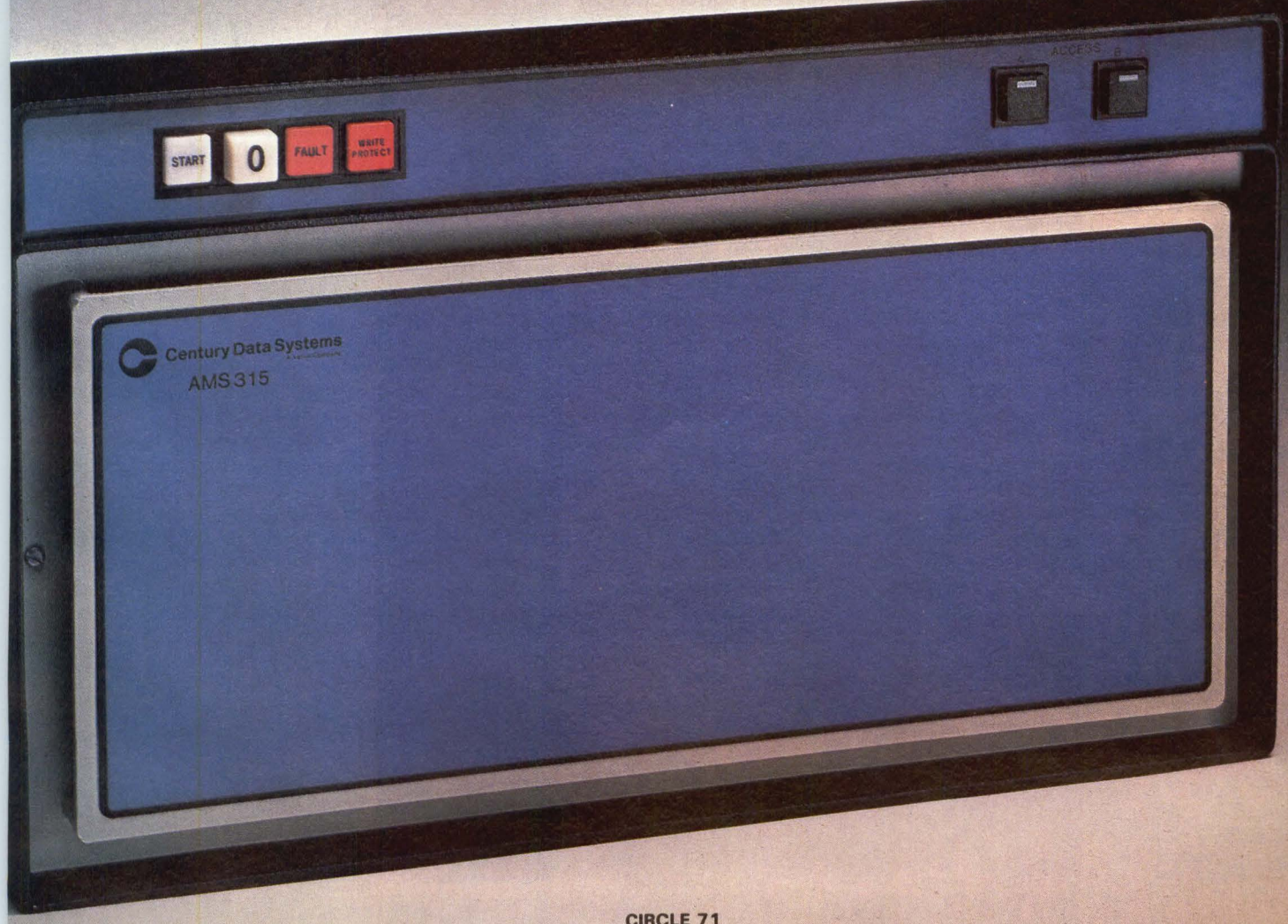
Century Data Systems, Marketing Communications C1-10, 1270 N. Kraemer Blvd., Anaheim, CA 92806, (714) 999-2660.

AMD House, Goldsworth Road, Woking, Surrey, England, GU 21 1JT, 44-4862-27272.

Century Data Systems

A Xerox Company

Finally, a Winchester that goes head-to-head, track-to-track, cylinder-to-cylinder, byte-to-byte with 300-MB removable pack drives.



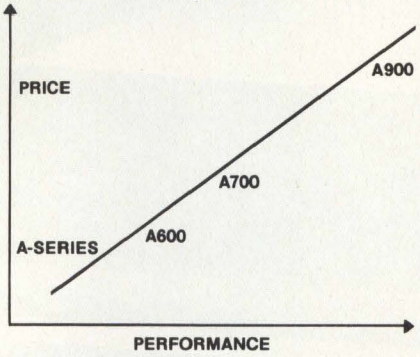
CIRCLE 71

See us at NCC Booth #S5210

How do you make a 3 MIPS real-time computer for under $15,000?

Simple. Hewlett-Packard's new HP 1000 A900 really makes things easy for OEMs with demanding industrial automation and process applications.

We made our computer exceptionally fast and rugged, as well as simple to use, expand and maintain. With state-of-the-art LSI technology, we were able to integrate the CPU and floating point hardware chips. We also included HP's Scientific Instruction Set and Vector Instruction Set firmware. Combined with a 4-kilobyte cache memory, two-level pipelined implementation and 3.7 megabytes per second I/O bandwidth, this made it comparatively simple to reach a CPU speed of 3 MIPS. As well as 560,000 floating point operations per second. All for an astonishingly low $14,818.



If price/performance is important in your business, you can't do better than this.

Since we used only a quarter the number of components that are in our previous top-of-the-line computer, the A900 is even more reliable and simple to maintain. MTBF is a healthy 8000 hours; average repair time a scant 90 minutes.

You'll have an easy time expanding your system, too. You can start with our standard 3/4-megabyte board, and move all the way up to 6 megabytes of 64K RAM error-correcting main memory. Without straining your budget. Because you can get this additional memory for just $3340 per megabyte.

The Automators: a well-matched family.

In our HP 1000 A-Series family, you'll find two other members with the same level of price/performance as the new A900. For example, the A600 micro-computer gives you 1 MIPS minicomputer capabilities for only $5K. The A700 minicomputer adds an easily customized microprogrammable processor. So, for just $10K, you can tailor its power to handle data acquisition, process control and supervision of several dedicated processors.

All three computers come in a range of configurations, from $2K micros to $50K super-minicomputer systems. They all support identical peripherals, making it simple to expand or add power any time you want. And we simplify planning your own system with a choice of nine graphics I/O devices, six CRT terminals, and a wide range of printers, disc drives and HP-IB compatible instruments.

A simple software story.

We made the software not just compatible but identical for the entire A-Series family. So you can interchange programs without any modifications at all. What could be simpler than that?

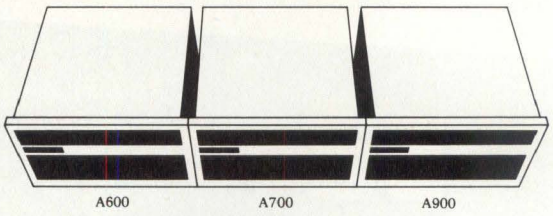
The family supports all major HP 1000 software packages, too. Including Graphics/1000 and IMAGE/1000 data base management. You can also use DS/1000-IV to network with the other HP 1000 or HP 3000 systems, as well as X.25 packet-switching datacomm software.

All the Automators utilize the new RTE-A.1 real-time operating system. This supports programming in FORTRAN 77, Pascal, BASIC and Macro Assembly languages.

A new program for OEMs.

This is going to make things much simpler for you. It's a package of new discounts and credits that will help you sell more and keep more for yourself.

For instance, we'll give you a 10% credit for HP add-ons a customer orders for your system. And a 6% credit on the net price of a system for which you supply the software. To help your cash flow, we're offering 40% discounts on demonstration and development systems, too.



The HP 1000 A-Series Automators provide a range of capabilities for real-time applications.

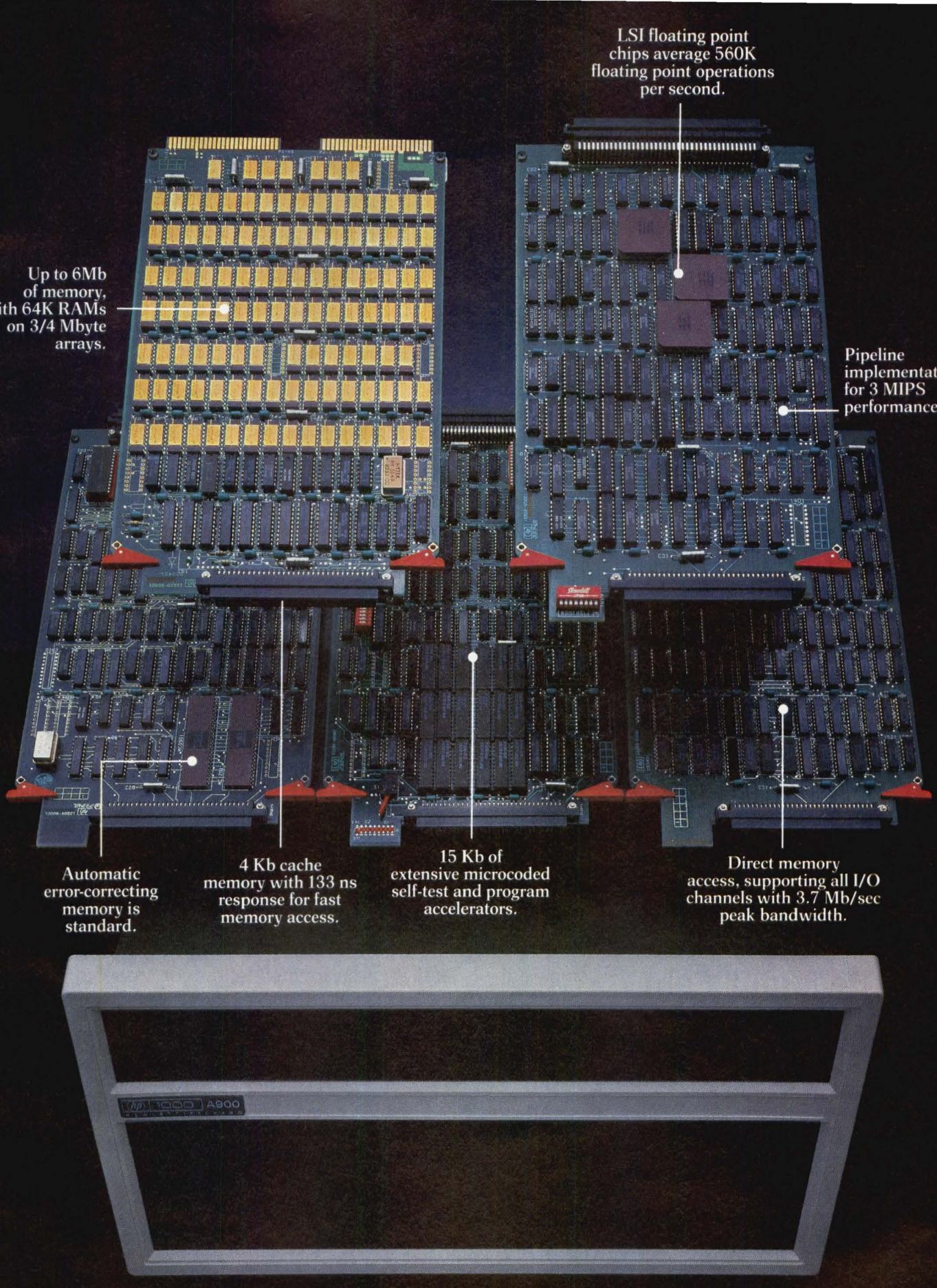
That's just for starters. Our new OEM program also involves competitive discounts, extended warranties, free training and much more.

So if you're looking for the best-performing real-time computers for the money—and a better-looking bottom line in the bargain—simply contact your nearest HP sales office. Ask a Technical Computer representative for complete details about the A-Series family and our new OEM plan. Or write to Joe Schoendorf, Hewlett-Packard, Dept. 11161, 11000 Wolfe Road, Cupertino, CA 95014.

Prices USA list, OEM quantities of 100

HEWLETT PACKARD

TC-02213


LSI floating point chips average 560K floating point operations per second.
Up to 6Mb of memory, with 64K RAMs on 3/4 Mbyte arrays.
Pipeline implementation for 3 MIPS performance.
Automatic error-correcting memory is standard.
4 Kb cache memory with 133 ns response for fast memory access.
15 Kb of extensive microcoded self-test and program accelerators.
Direct memory access, supporting all I/O channels with 3.7 Mb/sec peak bandwidth.

A900

CIRCLE 72

The MultiMode Printer with The Magnificent Fonts

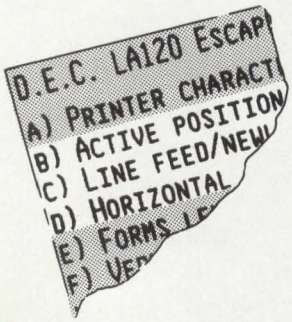


MultiMode Printer Offers Flexibility

. . . At a Sensible Price

"Flexibility" means instantaneous call up of any of this trend-setting machine's many features whether for *word processing, data processing, graphics* or *forms generation*. Using either of the two built in interfaces, an external keyboard or downloading from your computer, you can program the Qantex Model 7030 to do more.

The "Beautiful" Font



Compare the "Beauty" of our printed letters for the word processing fonts which include Cubic, Trend, Spokesman, Courier, Italics, Script, OCR-A, APL, Scientific plus *downloaded* fonts from your computer. Draft copy modes include 8 resident fonts — U.S., U.K., German, French, Spanish, Swedish, Finnish, Norwegian and Danish.

Other features include high resolution graphics — 144 x 144, single pass and double pass word processing, and 180 cps data processing modes and user defined formats.

Operator initiated, the MultiMode printer provides a complete printed status report of operating parameters and diagnostics.

For more information, or a demo, call us about the new Qantex Model 7030 MultiMode Printer.

See us at NCC Booth #W6240

CIRCLE 73

north atlantic
Qantex
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(516) 582-6060 (800) 645-5292

ncc '83 product preview

peripherals

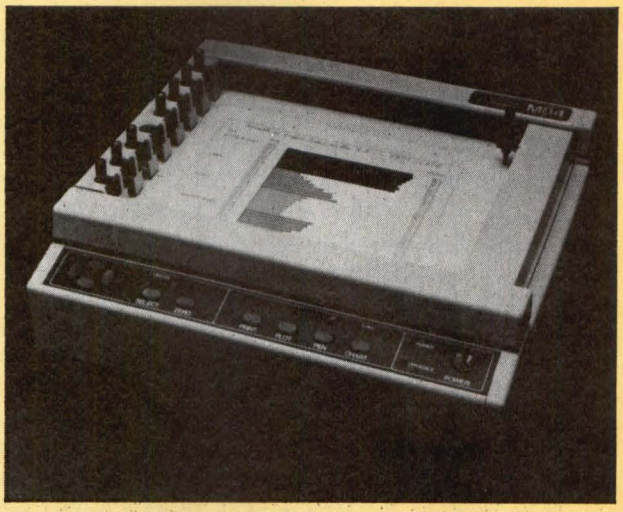
Video display terminals

Small Wonder is a plastic case terminal that offers a large page size, multiple pages, an array of video attributes, nonvolatile function keys, and a detachable keyboard. The "soft" keyboard and character generator allow the OEM to reconfigure the terminal to fit a range of applications. Available options include 32K of additional memory and composite video. Features include small footprint and green monitor. Also shown is SW10, a low cost alternative for the DEC VT-100. Adhering to the ANSI 3.64 standard, the terminal is packaged in a compact, injection molded plastic case. Capabilities include direct access to all terminal operating characteristics via the keyboard rather than switches. The unit has a keyboard setup mode, function keys, and a printer port with 132-col pass-through capability. Each of the 12 programmable function keys can store up to 20 chars of user-defined character/code sequences. ***General Terminal Corp***, 14831 Franklin Ave, Tustin, CA 92680.



See at Booth N3756 **Circle 280**

8-pen desktop color plotter



Model 84 plots on either ANSI A 8½" x 11" (21.6- x 28-cm) or DIN A4 287- x 200-mm paper in up to 10 colors. Liquid ink, nylon tip, or ceramicron-tipped pens can be used. A business graphics ROM allows users to plot bar, circular, or line graphs using simple commands. Plotting speeds up to 16.5 ips are attained with 0.004" resolution. Based on a Z80 microprocessor, the unit has built-in firmware commands that include 5 line styles, selectable character rotations, special symbols, 6 different character sets, viewporting/windowing, scaling, and circle/arc generation.

The plotter's print mode enables users to verify the configuration when in self-test mode and to print out plot commands. Three interchangeable interfaces are provided: RS-232-C, IEEE 488, or Centronics parallel. With the RS-232-C interface, baud rates from 110 to 9600 bps are switch selectable, as is parity selection. ***California Computer Products, Inc,*** 2411 W La Palma Ave, Anaheim, CA 92801.

See at Booth N3838 **Circle 281**

Plain paper printing terminal

Execuport 443 contains 16K bytes of memory with editing functions to permit modification of data stored in memory. Editing commands allow operators to locate, change, delete, and correct data, or to repeat an instruction. Information can be saved, erased, and moved by depressing keys. Thirteen programmable keys permit insertion of recurring phrases while building files. Files stored under these program keys can also be read and programmed by a remote device. Data can be stored for later transmission or for editing while main memory is used for another function. A battery backup option provides permanent data storage for up to 1 yr. This nonvolatile configuration can be programmed from the keyboard or remotely configured. Communication speed is selectable over the range from 110 to 1200 baud. The unit is Telex I and II (TWX), International Telex, and DDD compatible and is operational in both originate and auto-answer modes. ***Computer Transceiver Systems, Inc,*** PO Box 15, E 66 Midland Ave, Paramus, NJ 07652. **See at Booth P7213** **Circle 282**

peripherals

Flat focus CRT displays

DTG high performance displays for word processing, interactive graphics, and text editing come in 12″ (30-cm), 15″ (38-cm), and 17″ (43-cm) sizes. Both horizontal and vertical formats are available. The displays are designed for uniform flat focus, eliminating the need for electronic dynamic focus circuitry. Available with a variety of phosphor options, the displays can be configured to accept TTL level direct drive input depending on user requirements. Internal controls on the single PCB include video contrast, brightness, horizontal width, horizontal linearity, vertical height, vertical frequency, and vertical linearity.

The displays are built with lightweight steel chassis or can be supplied in kit form for incorporation in user housings. External brightness and contrast controls as well as a 110/220 Vac power supply are optional. ***Dotronix, Inc,*** 160 First St SE, New Brighton, MN 55112. **See at Booth P7242** **Circle 283**

Graphics processing system

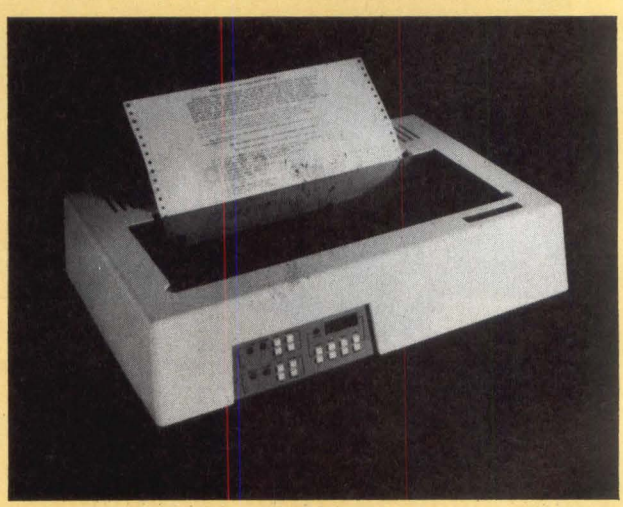
QUIC-RIP (raster image processing) gives nonimpact printers the ability to do letter quality word processing; industrial graphics and bar coding; bit-mapped graphics for business, scientific, and CAD/CAM applications; intermixed fonts, multiple forms overlay, EDP line printing; and multipage collated document printing. The operator can send simple print instructions in the normal data stream, simplifying procedures and eliminating the need for software packages. Interfaces available are Centronics, Dataproducts positive and negative true, RS-232, and active and passive current loop. Protocols include IBM 3270, IBM 3271, IBM 3272, IBM 3274 A and B, IBM 3276, IBM System 34 and 38, IBM 2780, IBM 3780, IBM 8100, Burroughs TC500 and TC3500, synchronous or asynchronous TDI, NCR 8200, NCR 9020, RS-449 serial, Wang VS, and Ethernet. ***Quality Micro Systems,*** PO Box 81250, Mobile, AL 36689. **See at Booth P7601** **Circle 284**

Multimode dot-matrix printer

DS220 offers 3 operating modes including high speed printing for data processing, near-letter quality for word processing, and high resolution graphics for charts. The operator control panel allows programming of up to 50 different features for forms control, communication, and font selection. These values can also be set via the data stream. They are stored in nonvolatile memory, eliminating the need to reconfigure after power-down.

Both RS-232-C and Centronics compatible parallel interfaces that use a 2000-char FIFO print buffer are included. Either X-ON/X-OFF or data terminal ready restraint protocols can be selected for communication synchronization. The bidirectional, logic seeking unit outputs a 9 x 7 matrix in draft mode at 220 cps, while an 18 x 48 matrix provides near letter quality at 40 cps. The unit prints 132-col lines at 10 cpi with selectable expanded characters at 5 cpi.

Standard features include top of form, horizontal and vertical tabs, as well as perforation skip over, auto line feed self-test, 3″ to 15″ (8- to 38-cm) tractor feed, pinch roller feed, superscripts, subscripts, 7 international char sets, and baud rates from 110 to 9600. ***Datasouth Computer Corp,*** PO Box 240947, Charlotte, NC 28224.



See at Booth D0122 **Circle 285**

Desktop engineering terminal

Whizzard® 1645 is the black and white version of the 1650 color terminal. The 1645 has higher pixel resolution, 1280 x 980, as well as interactive graphics concurrent with alphanumeric capability. Compatible with the DEC VT-100/52, the terminal allows users a full range of graphic design functions, software development, and documentation and report generation. Tektronix 4014 emulation will be an available option.

The Whizzard 1600 series is compatible with the company's WAND software and offers the graphics functionality of larger, more expensive 6200 and 7200 computer graphics systems. ***Megatek Corp,*** 3985 Sorrento Valley Blvd, San Diego, CA 92121. **See at Booth N3826** **Circle 286**



Tell me two bright ideas for solenoid and motor driving

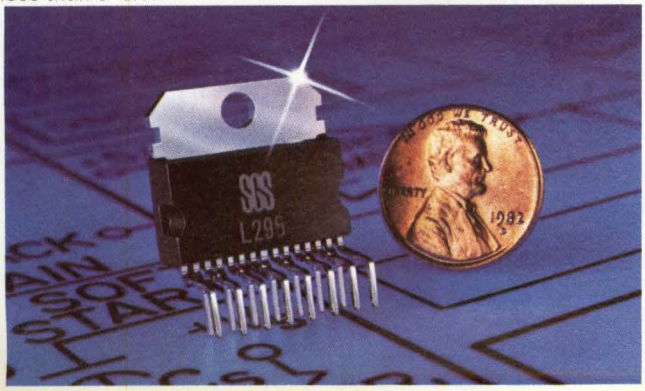
L295 High-Power, Dual Half Bridge Driver

The L295 is a dual half-bridge switchmode driver for either two solenoids or one phase of a stepper motor. Applications include hammer driving in matrix printers and stepper motor driving in either paper feed mechanisms or electromagnetic controllers.

The device incorporates two independent channels with separate inputs and outputs to provide all functions necessary for direct interfacing between digital circuitry and two inductive loads. The output current is completely controlled by switching techniques resulting in a very efficient operation. Dual supplies allow interfacing with peripherals running at voltages higher than logic.

The L295 drives loads up to 2.5A per channel from a 50V supply. Additional features include thermal protection and a minimum number of external components.

These devices assembled in the popular Multiwatt® package feature easy mounting and a low thermal resistance ($R_{th\ JC}$) of less than 3°C/W.



L294 High Power Solenoid Driver

The L294 functions as a transconductance amplifier to power solenoids in printer, hammer, and needle matrix applications. The device drives one solenoid from a supply of 50V with an output current of up to 4A.

The switchmode control of the output current allows high speed driving of electromechanical actuators with increased efficiency and reduced power dissipation.

Additional features of the L294 include thermal protection and diagnostic circuitry with latched output for recognizing conditions such as coil short circuit.

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CIRCLE 74

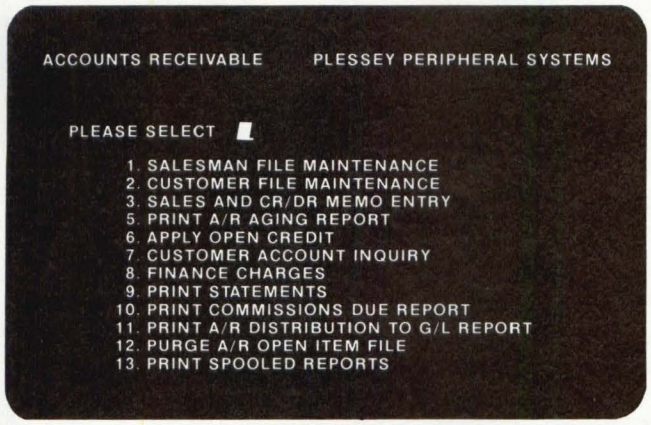
Introducing the money-making micro-mini DEC™-UNIX™-CP/M™-MUMPS™ universal 16-bit workstation.

(Whew!)



If you're selling small business systems and software, you're leaving money on the table.

Because you could pick up a lot more of what we're all here for with the Plessey Series/6000 Small Business Computers.



Your business is our business.

With the 16-bit Plessey Series/6000, we've made it our business to support your business.

Our computers are based on DEC's LSI-11™ micros, so you start with proven hardware that's in thousands of systems world-wide.

We've made them available in a wide range of configurations, so you can provide exactly the power your customers need.

Start with the low-cost System 6100, a 64 kbyte single-user workstation. Or for multi-users, choose the economical System 6200 with 256 kbytes of main memory (expandable to a full megabyte). Both use the Q-bus and come in a compact 5¼" chassis available in desktop and rackmount configurations.

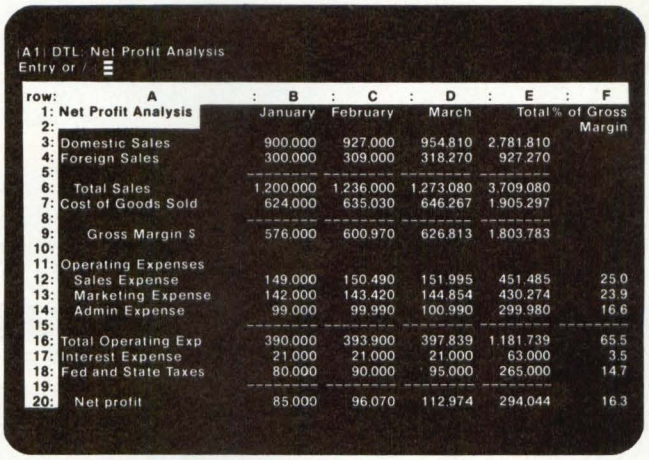
And for the big jobs, go to our System 6600 and System 6700 to get the full power of a 22-bit minicomputer. From 256 kbytes to 4 megabytes of main storage. An 84 megabyte 8" Winchester disk. Q-bus for communications and other peripheral interfacing. And all in a 10¼" chassis at a price that's easy to take.

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And the programs you develop on the single-user system are just as useful on the most powerful Series/6000 configuration, so your customers have an easy growth path.



row:	A	B	C	D	E	F
1:	Net Profit Analysis	January	February	March	Total	% of Gross Margin
2:						
3:	Domestic Sales	900.000	927.000	954.810	2.781.810	
4:	Foreign Sales	300.000	309.000	318.270	927.270	
5:						
6:	Total Sales	1.200.000	1.236.000	1.273.080	3.709.080	
7:	Cost of Goods Sold	624.000	635.030	646.267	1.905.297	
8:						
9:	Gross Margin $	576.000	600.970	626.813	1.803.783	
10:						
11:	Operating Expenses					
12:	Sales Expense	149.000	150.490	151.995	451.485	25.0
13:	Marketing Expense	142.000	143.420	144.854	430.274	23.9
14:	Admin Expense	99.000	99.990	100.990	299.980	16.6
15:						
16:	Total Operating Exp	390.000	393.900	397.839	1.181.739	65.5
17:	Interest Expense	21.000	21.000	21.000	63.000	3.5
18:	Fed and State Taxes	80.000	90.000	95.000	265.000	14.7
19:						
20:	Net profit	85.000	96.070	112.974	294.044	16.3

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For more details, contact Plessey Peripheral Systems, 17466 Daimler, Irvine, CA 92714.

Or better yet, call (800) 854-3581 or (714) 540-9945 in California today. Because we all know that time is money.

PLESSEY

CIRCLE 75

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"Image processing has never been simpler...or more powerful"

Introducing Comtal's new Vision Two—another step forward in image processing
Discover a new world of image processing with our new Vision Two Series systems and CIPAL—Comtal's Image Processing Application Library. Together they provide all the capability of high-performance, hardware-based image processing at an entry level price. At another level, it contains a powerful 32-bit processor with Fortran to create your own programs, and features real-time, interactive operation. And, in between are hardware and software configurations to handle any image processing situation.

An expert system for non-experts
If you're a first time user of image processing, you don't need to be a computer expert. Comtal gives you a complete turnkey system that's simple to use. It's a self-contained, standalone system that combines Comtal's renowned image processing architecture with an embedded host computer and a selection of CIPAL programs. The Vision Two also interfaces with any DEC-compatible minicomputer. The basic system includes a 150 megabyte Winchester disk for program file and image storage and a magnetic tape drive. Images may be displayed at either 512^2 or 1024^2 resolution.

An expert system for the experts
For highly complex image processing applications, the Vision Two comes with an embedded VAX 11/730 as its host. Using Fortran, you can develop your own sophisticated analysis and interpretation programs, or use existing image processing programs written in Fortran.

With expert level software support
With the Comtal Image Processing Application Library, you have a wide selection of software from specific application programs to general software routines. For example, we have developed a special version of the VICAR image processing and geographic information system with features that also make it a powerful software program for general image processing applications. And, there are our standard functions such as image subtraction, contrast enhancement, noise reduction, edge enhancement, image transformation and linear warping as well as a variety of utility routines.

The flexible, modular approach to image processing
With the Vision Two, you have your choice of four standard Comtal systems, three embedded hosts, and an array of software programs:

Image Processing System	Embedded Host	Software
8000-R Series Vision One/10 Vision One/20 Vision Ten/24	LSI 11/23 or PDP 11/24 or VAX 11/730	Comtal Image Processing Application Library

Find out how image processing can be simpler and more powerful. Call or write Comtal, a subsidiary of 3M, 505 West Woodbury Road, Altadena, California 91001 (213) 797-1175.

COMTAL 3M

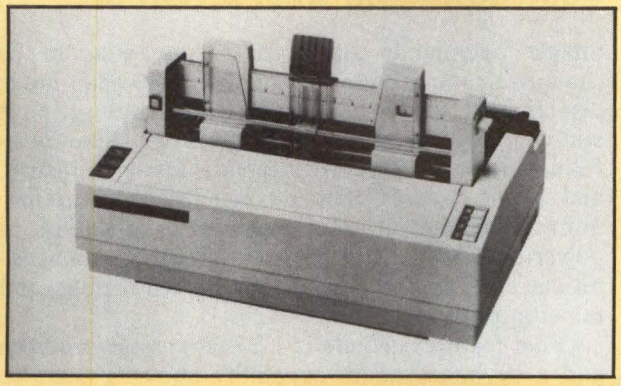
See the Vision Two at NCGA Booth #2037
and at Siggraph Booth #235

CIRCLE 76

ncc '83 product preview

peripherals

Dot-matrix printers



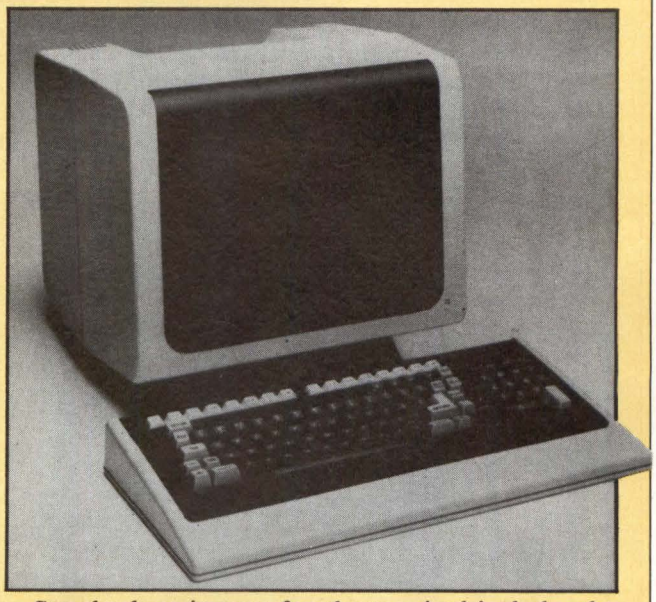
Using seamless and endless cartridge-type ribbon, KX-P1160 is a bidirectional 16-pin printer with logic seeking head that is designed to print up to 196 cps. Its 9 x 13 dot matrix forms 96 ASCII characters with descenders. The unit's adjustable sprocket pin feed can handle fanfold paper from 4″ to 15″ (10 to 38 cm) in width. An optional front inserter is available for single sheets. Equipped with a standard parallel interface, the printer has an optional RS-232-C interface. Microprocessor-controlled line spacing allows automatic selectable spacing, both forward and reverse. Model KX-P1090 also features an endless and seamless cartridge ribbon. A bidirectional 9-pin printer with graphic capabilities, it can print 96 cps and up to 80 chars/line. This printer accommodates fanfold and letter paper from 4″ to 10″ (10 to 25 cm) in width or an 8.5″ (21.6-cm) roll of paper. It uses an adjustable sprocket pin feed or friction feed to handle the paper. A parallel interface is standard; RS-232-C interface is optional. ***Panasonic Industrial Co***, 1 Panasonic Way, Secaucus, NJ 07094. **See at Booth N3556** **Circle 287**

Serial dot-matrix printer

Heavy duty dot-matrix printer SLP-160 prints clear copy at 120 cps. Operating bidirectionally, it can print 162 chars/line maximum (Elite: 12 pitch), putting 2 pages of CRT screen information on a single hard-copy page. Vertical/horizontal dot pitch ratio is 1 to 1. The unit operates quietly, producing 65 dB or less (measured 1 m in front of the printer tractor). A temperature sensor in the main unit causes the cooling fan to operate automatically when the inside temperature reaches a certain degree, keeping the printer's durability longer and its operating efficiency smoother and higher. ***Sord Computer of America***, 200 Park Ave, New York, NY 10166. **See at Booth P7442** **Circle 288**

User definable video terminal

Although ERGO 201 emulates Televideo 925, ADM3A, and Micro-Term ACT-5A, it includes a custom mode that allows the user to define the terminal's control codes and escape sequences, as well as save these designations in nonvolatile memory. Custom mode allows the user to configure terminal functions to match existing software; it can also be programmed for most ADDS and Hazeltine applications. This capability, coupled with 16 host definable or user-programmable function keys, eliminates the need for software modification.



Standard equipment for the terminal includes the programmable function keys and 5 video attributes that can be used in any combination without a character space. Other features include a detached keyboard with LEDs, built-in tilt mechanism, and 2-speed smooth scroll. Characters are displayed in a 7 x 9 matrix with true descenders on a green, nonglare screen with screen saver. Amber phosphor is also available.

Options include an alternate character generator with 128-char capability, 2 pages of memory, and a graphics board with PLOT 10 and ReGIS capability. ***Micro-Term Inc***, 1314 Hanley Industrial Ct, St Louis, MO 63144. **See at Booth S5097** **Circle 289**

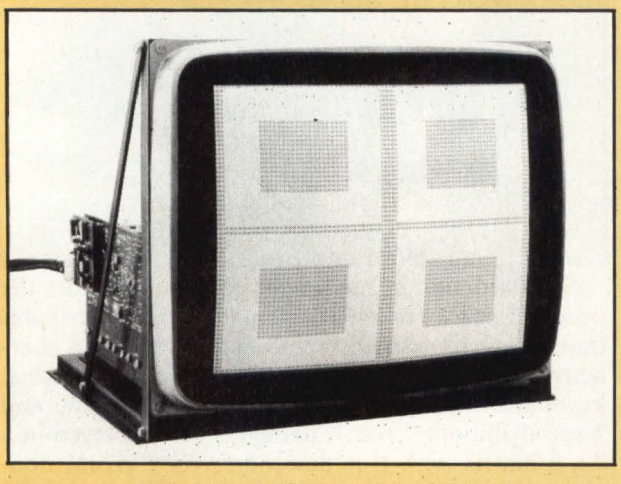
NOTE: "A" series booths are located in Anaheim Convention Center's Arena, "N" series in the North Hall, "S" series in the South Hall, and "W" series in the Southwest Hall. "P" series booths are in the NCC Pavilions adjacent to the Registration area. "D" series booths are located in the Disneyland Hotel Convention Center.

peripherals

Compact 2000-lpm band printer

Model 2000 band printer is designed for high speed, high volume OEM printing applications, but departs from older, more bulky printers in its compact size. Advanced diagnostics, superior print quality, and reliable paper handling are built into this 2000-lpm printer. Operator changeable formats in 48-, 64-, and 96-char sets are available in various print styles and sequences. Also shown will be the BT-1500 duty cycle band printer. This unit offers print speeds of 1500 lpm with a 48-char set, 1200 lpm with a 64-char set, and 900 lpm with a 96-char set. Self-diagnostics, microprocessor control, quietized cabinet, and electronic character alignment are standard features. *Data Printer Corp*, 99 Middlesex St, Malden, MA 02148. **See at Booth N3748** **Circle 290**

Raster scan graphics monitors



VR-1000 provides 100-lpi resolution in both vertical and horizontal dimensions with up to 8 levels of intensity. The raster scan monitor displays up to 1100 noninterlaced lines refreshed at 60 frames/s. The displays run at a pixel level of up to 100 MHz. A display of 1024 x 1024 is attained.

At the pixel level, the video has a rise/fall time of less than 5 ns. Either the very fast white phosphors (P-4 type) or the very fast green phosphors (P-31 type) can be used at the 60-Hz frame rate. Horizontal frequency of the monitors is 31 to 68 kHz.

Available in 15″ (38-cm), 17″ (43-cm), or 20″ (51-cm) sizes, the displays are available on an OEM price schedule. *Moniterm Corp*, 7180 Shady Oak Rd, Eden Prairie, MN 55344. **See at Booth P7439**
Circle 291

User definable ANSI terminal

Simple commands allow the Genie+Plus to be changed from a conventional 24- x 80-char mode display unit to a 30-line terminal with multiple page and window capability, or a structured offline form-filling terminal with protect, guard, numeric, justify, and security areas. Commands can also be loaded into nonvolatile memory for automatic execution at power-on. This permits the user to redefine fault conditions such as keyboard layout, screen format, and tab-stop positions.

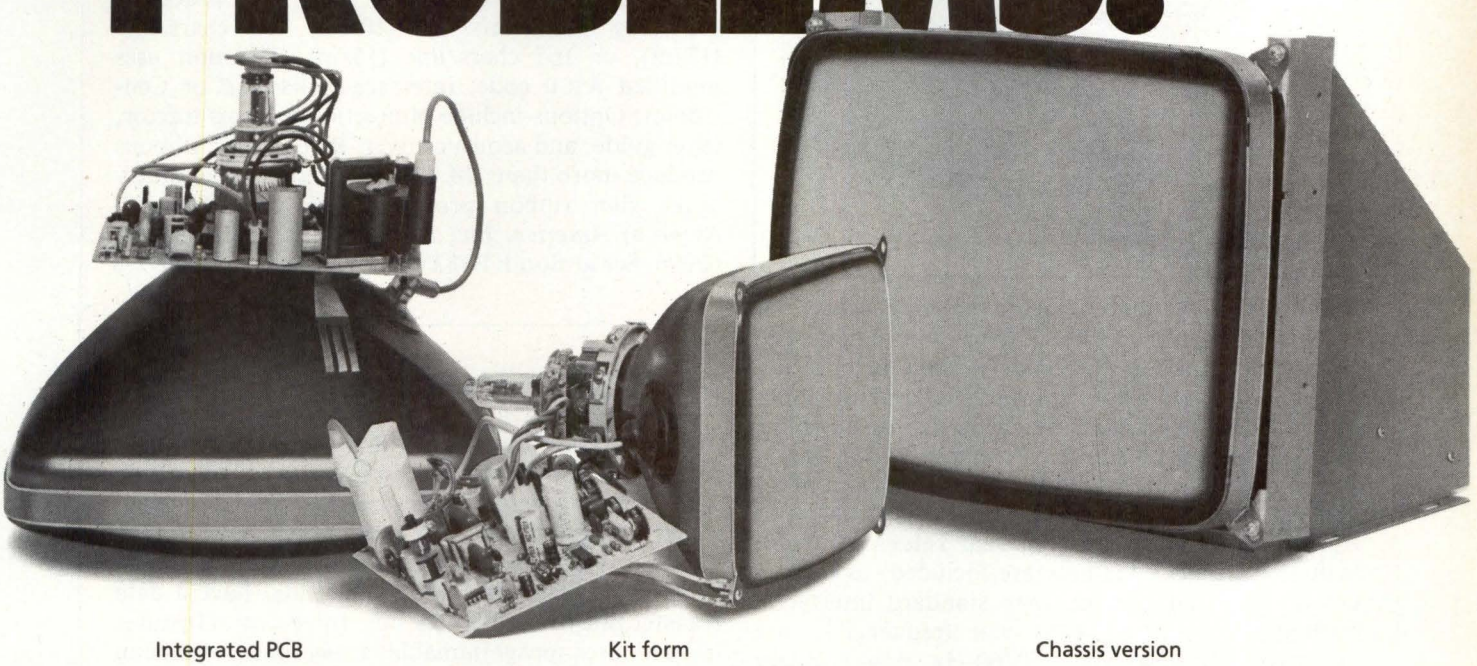
Other features include 15″ (38-cm) nonglare screen and a keyboard zoom capability allowing users to move data on and off the screen as well as trade character size with the amount of data displayed. A 60-line, 4800-char memory allows the user to review data previously scrolled off the screen. Absolute control of cursor location is maintained by 2 independent cursors while allowing the host to write independently to another area of the screen.

Thirty-eight programmable keys can be loaded with any sequence of ASCII codes, without restrictions on the number of codes/key. Most keys permit different sequences on the shifted and unshifted levels. Commands can be embedded within the key sequences to control whether the key repeats and/or whether the string is sent to the host or executed locally. Available options include DEC mode, green phosphor tube, and 230 Vac. An RS-232 printer output capability includes both local and remote copy functions and screen print. *Ann Arbor Terminals Inc*, 6175 Jackson Rd, Ann Arbor, MI 48103.



See at Booth W6613 **Circle 292**

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CIRCLE 77

peripherals

Plain paper printing terminal



Along with DEC and Videotex compatibility, 780 series teleprinters provide 120-cps throughput and 212A/103/V.21 modem options. The line includes RO, KSR, and MSR models for portable or desktop applications. The Teleprinters are keyboard or downline configurable for all standard communication protocols and can include a built-in keyboard and auto-dialing, auto-answer modem for direct connection to DDD, TWX, Telex, or International Telex. Electronic mail and graphics features are included, as well as EIA (CCITT V.24), and dc loop standard interfaces. National characters, CCITT V.21 frequencies, and switchable 120/240-Vac, 50/60-Hz power adapt them for international applications. ***Qwint Systems, Inc***, 3693 Commercial Ave, Northbrook, IL 60062. **See at Booth P7354** **Circle 293**

400-lpm band printer

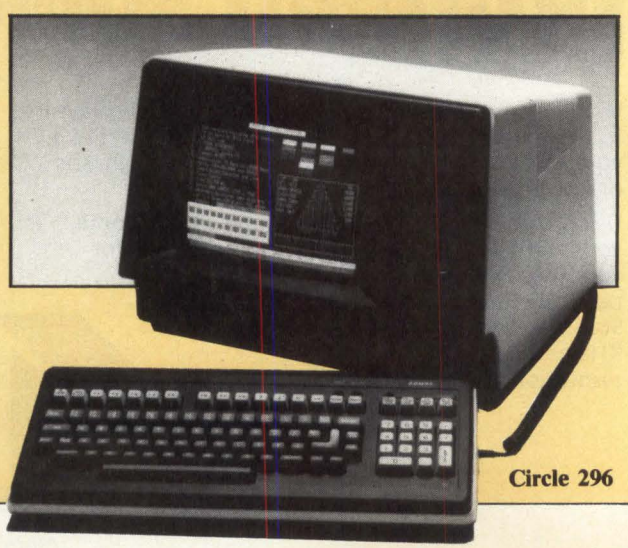
Linewriter 400 uses a linear hammer design to obtain a flat impact on the paper and to provide high print quality at high speeds. Microprocessor control allows early end of print implementation (the machine knows when it has printed all characters on a line). It also allows use of statistical bands (frequently used characters occur more often on the band) on the printer. The unit's modular design puts all components within reach when the front cover is opened, including the lift out hammer bank. A 4-digit display communicates results of self-test diagnostics to the operator. The floor standing unit is desk height, approx 35″ (89 cm), and is contained in a 64-dBa cabinet for data processing use. ***Centronics,*** 1 Wall St, Hudson, NH 03051. **See at Booth N3600** **Circle 294**

Serial impact printer

With an average printing speed of 20 chars/s (Shannon text 1/12 pitch), the compact V-shaped guide double daisy wheel in this printer produces clean, accurate output on 13″ (33-cm) wide paper. Character selection and print position for the RP1200N impact printer are controlled by a microprocessor providing 110 chars/line (10/in), 132 chars/line (12/in), or 165 chars/line (15/in). The unit uses modified ASCII code; interface is RS-232-C or Centronics. Options include bidirectional forms tractor, letter guide, and acoustic cover. Black fabric ribbons produce more than 1M chars/cassette. Black multistrike film ribbon provides 250k chars/cassette. ***Ricoh of America, Inc***, 20 Gloria Ln, Fairchild, NJ 07006. **See at Booth P7835** **Circle 295**

CRT display terminal

ABM 85H has a detached tactile touch keyboard, high resolution P-31 phosphor display, advanced editing with protected fields, monitor mode, full video attributes, and 128 displayable character codes. Two RS-232-C ports are used for asynchronous communications. Both ports are bidirectional and have a data transfer rate of up to 19.2k bps. Incremental features include user programmable answerback, function key, and attribute storage in nonvolatile memory; hidden attributes; and graphics and math symbol character sets. Incremental options include up to 8 pages of data storage and a 1200-bps modem. Control, escape, and keyboard codes can be customized. ***Kimtron Corp***, 2225-I Martin Ave, Santa Clara, CA 95050. **See at Booth P7518**



Circle 296



MODEMS SHOULD BE HEARD AND NOT SEEN.

As you can't see, the terminal on the left has a low-cost Rockwell R24DC modem built in. It's connected directly to the U.S. dial-up network with nothing more than a standard telephone jack. No acoustic coupler. No phone. No tangled wires.

It's easy to connect the R24DC modem inside your terminal. It's LSI-based, with the entire 2400 bps modem and data access arrangement on a single 5"x 7.85" plug-in card. With power requirements of ±12V and +5V, it consumes only 3 watts.

Rockwell's R24DC integral modems are FCC-registered and both Bell- and CCITT-compatible. And they're widely used in point-of-sale terminals, and for cleaning up PBXs, data concentrators and data communications devices.

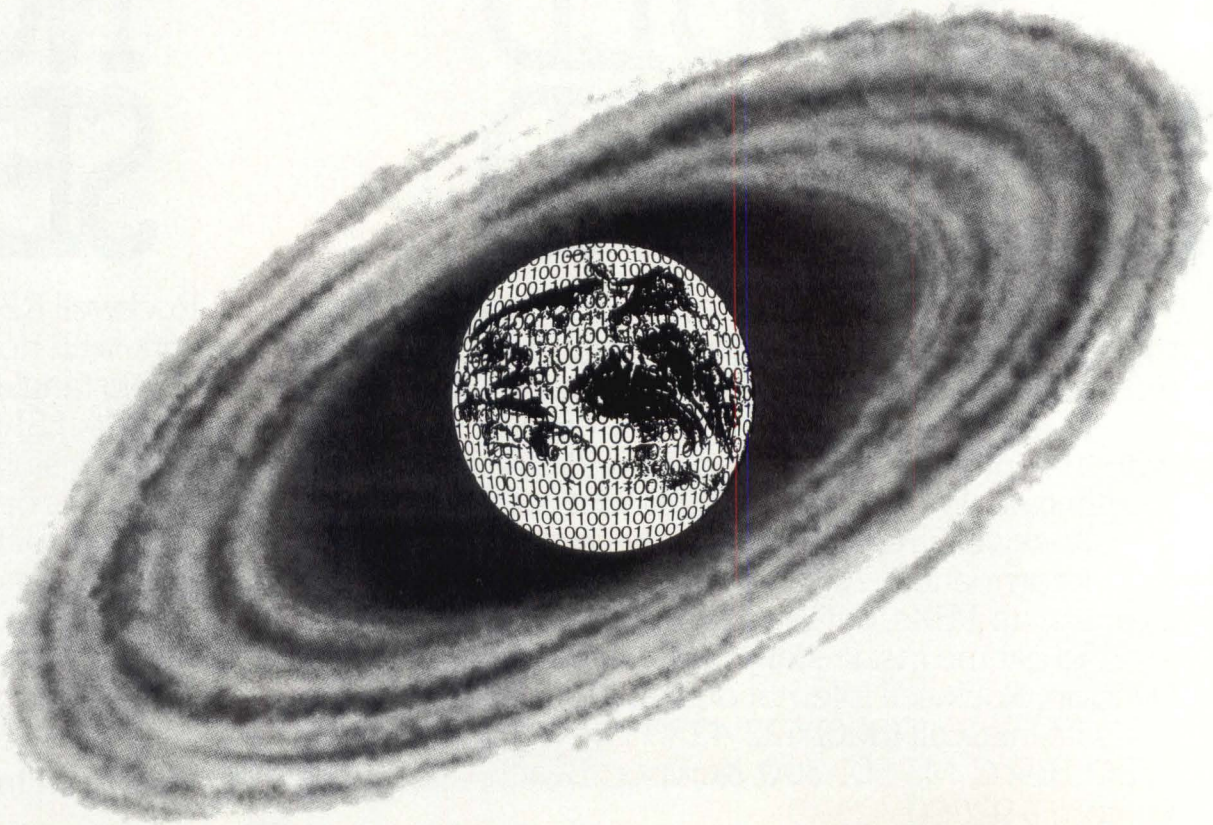
To get the inside story on Rockwell modems, call the Electronic Devices Division, Rockwell International at (800) 854-8099. In California, call (800) 422-4230. Or write us at P.O. Box C, MS 501-300, Newport Beach, California 92660.

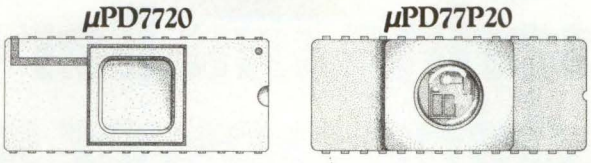
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CIRCLE 78

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Now you can get all the advantages of digital signal processing for real-time voice-band applications. With NEC's μPD7720 signal processor.

Our μPD7720 Signal Processing Interface has the power to handle virtually any digital signal processing application this side of the Milky Way.

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Of course, like all NEC products, every μPD7720 is performance tested, and backed by our reputation for quality and reliability.

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It really doesn't take a lot of "know-how" to know how to get OEM open-frame switching power supplies that best suit your applications–when your needs are for only a few, a few hundred or a few thousand units. The Sorensen SRM Series of multiple output switching power supplies is cost effective, reliable, and units are in stock... ready to ship. Call your Sorensen representative for prices and delivery.

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Sorensen is a Raytheon company. So every product designed and manufactured by Sorensen is backed by Raytheon technical expertise, manufacturing know-how, and world-wide sales representation. When you buy a Sorensen power supply, you are doubly assured of uncompromising product design, quality and service.

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No need to rely on hit-or-miss or almost-right designs. Six standard SRM units, with open frame design (cover optional), can quickly and easily be customized and shipped to meet your delivery needs–*and* your tightest specifications.

Highly stable, efficient.

The Sorensen SRM Series provides highly stable outputs: +5Vdc, ±12/15 Vdc, and a floating output of 5 or 24 Vdc. Total output power to 200 watts. Efficiency is 80% typical for semi-regulated units, 70% typical for fully-regulated units.

You're protected.

The SRM Series has standard 115 V and 230 V inputs. Overvoltage protection trips at 6V ±5%, and will shut down all outputs. Main and fully-regulated auxilliary outputs have current foldback for protection against short-circuit. Semi-regulated outputs are protected by fuses. All SRM units will automatically shut down on ac undervoltage.

U.L. listed to make your manufacturing job easier, with greater reliability assured.



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Founded in 1943, Sorensen was the first commercial firm to manufacture and market precision electronic voltage regulators and power supplies.

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TWX: 710-220-1339



CIRCLE 80

RAYTHEON

software

Database and graphics packages

Available software for the Professional Computer has been extended to include a database package that enables users to create, sort, query, and gather information before output, then merge the data into spreadsheet or word processing format. Data processing and word processing functions are integrated so that field variables can be inserted into a word processing document. The data dictionary centralizes data descriptions and definitions of record types, fields contained in each record, and record views. Color graphics software that formats statistical information in bar, line, and pie charts complements the database package. As a general purpose program, it manipulates or stores continuous and discrete data, then transforms the data into detailed color images.

An enhancement for the Digital Voice Exchange (DVX)—an automated voice communication system that allows a user to receive, create, and send voice messages to one or more people—will also be displayed. When attached to an OIS 145, the DVX option adds voice messaging capabilities to the word processing functions. A DVX message management system allows non-DVX users to leave messages for DVX registered subscribers. ***Wang Laboratories, Inc,*** 1 Industrial Ave, Lowell, MA 01851. **See at Booth N3926** **Circle 297**

GKS graphics software

Graphics subroutine package complies with the highest level of the Graphical Kernal System (GKS) software standard. This standard, the Draft International Standard ISO/DIS 7942: Information processing GKS, Function Description, specifies a 2-D interactive graphics subroutine package. GKS Level 2B runs on all of the company's 32-bit processors under the Advanced Operating System/Virtual Storage. Application code is device independent, enabling packages to be used on various peripheral devices. Level 2B also supports an extensive selection of generalized drawing primitives such as line, arc, and sector, and device-independent display lists. In addition, the package supports graphics displays, including the DASHER® D450, G300, and G500, as well as the GDC/1000 graphics board set, and GW/4000 expert workstation. ***Data General Corp, Technical Products Div,*** 4400 Computer Dr, Westboro, MA 01580. **See at Booth S5174** **Circle 298**

Network management package

Overlord controls configuration, monitoring, testing, record keeping, performance analysis, and trouble signaling for data networks and multicomputer environments. Written in a standard language to adapt to most minicomputer and mainframe protocols, the program will first be applied to a Hewlett-Packard minicomputer. Color graphics and lightpen menu selection provide remote control interface ranging from terminal identification to mainframe configuration and network/data processing management. Report generation includes detailed equipment status, failure trends, and maintenance downtime. A trouble ticket reporting/monitoring function has been developed for critical computer and data communication environments. ***T-Bar Inc,*** 141 Danbury Rd, Wilton, CT 06897. **See at Booth W6370** **Circle 299**

Matrix solving library

A library of fast matrix algebra routines for use on the FPS-164 attached processor, FMSLIB offers routines coded to optimize use of the processor's architecture, allowing it to solve matrix problems at the theoretical speed of the hardware. Routines use asynchronous disk data transfers to operate on rows of the matrix as if the entire matrix were in main memory, accommodating matrices too large to fit in main memory. Divided into 4 segments according to the type of matrix to be solved, the library consists of real symmetric, real unsymmetric, complex symmetric, and complex unsymmetric modules. ***Floating Point Systems, Inc***, PO Box 23489, Portland, OR 97223. **See at Booth N3916** **Circle 300**

Bisync communications utility

As an option to the operating system, a bisynchronous communications utility lets OASIS-8 based microcomputers communicate bidirectionally with minicomputers and mainframes. Emulating standard IBM 2780/3780 protocol, it improves the coordination of data processing by permitting interactive communication. ***Phase One Systems, Inc***, 7700 Edgewater Dr, Suite 830, Oakland, CA 94621. **See at Booth D2011** **Circle 301**

ncc '83 product preview

software

R/M COBOL for microcomputers

Ryan-McFarland COBOL is available for the Universe line 68000 based computers. Running under UNOS operating systems, a UNIX-compatible system with extensive realtime, transaction-oriented capabilities, it runs simultaneously with other languages including Pascal, BASIC, and FORTRAN in multiterminal systems. This version of COBOL uses proposed industry standards for record keeping and file locking for UNIX-compatible systems. Record and file locking are essential to effective implementation of multiuser systems. ***Charles River Data Systems, Inc,*** 4 Tech Cir, Natick, MA 01760. **See at Booth P7618** **Circle 302**

Integrated OS-9 software

TMP (total management planning) packages include TMP/MANAGER, a structured database manager; TMP/CALC, an electronic spreadsheet that eliminates wraparound; and TMP/FREEFORM, an electronic index card package that fills the void between a structured DBMS and word processing. TMP/FRONT END integrates the other TMP packages and also links the system with word processors, BASIC, COBOL, and other high level languages. All application packages are ready to run on an off-the-shelf basis, and each also functions as a standalone program. ***Smoke Signal Broadcasting***, 31336 Via Colinas, Westlake Village, CA 91362. **See at Booth P7049** **Circle 303**

Decision-support language tool

Mapper organizes, manipulates, and extracts information needed for planning and controlling businesses from a data base. Users can manipulate data without the help of their DP department. Applications include budget planning, sales analysis, inventory control, production scheduling, and transportation routing. An integrated automated office system developed for medium and large organizations is also being shown. Personal and office computing, electronic mail, voice service, and word and data processing are combined in 1 integrated system, in 1 desk station for all levels of office personnel. ***Sperry Univac***, PO Box 500, Blue Bell, PA 19424. **See at Booth S5462** **Circle 304**

Database management system

RTFILE® an interactive relational database management system, is combined with a nonprocedural application generator for DEC RT-11 users. The menu-driven, CRT screen-oriented DBMS is available for users of RSX-11M and RSX-11M+ DEC operating systems. A VAX/VMS version is planned. Interactive features include database definition; forms generation; transaction processing; and sort, selection, and calculation specifications. Program language interfaces include FORTRAN, Pascal and MACRO. Report generation, multifile linking, and list processing are also included. The package currently runs under CTS-300, TSX+, STAR-11, SHARE-11, and UNIX operating systems. ***Contel Information Systems, Systems and Software Div,*** 4330 East-West Hwy, Bethesda, MD 20814. **See at Booth P7825** **Circle 305**

8086 cross-development tool

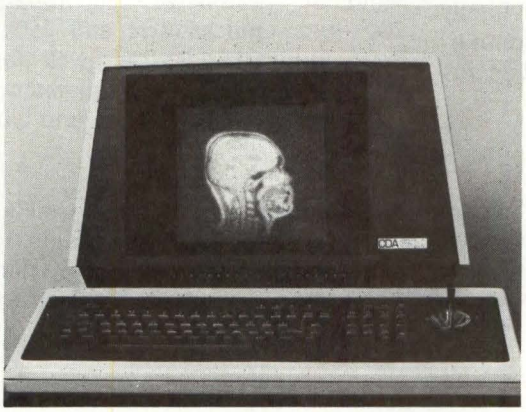
MicroSET-86 high level language symbolic cross-debugger now runs on Data General's MV series 32-bit minicomputers and supports debugging of 8086 assembly language modules. Designed to run on computers such as the DEC VAX and IBM/370 or compatible machines, the package produces object code for target 8086 based systems.

The software supports a fully extended Pascal compiler and includes an Intel-compatible linker, locater, and assembler. Host-target communication programs, a powerful multimode symbolic cross-debugger, and utilities are also included. ***First Systems Corp,*** 865 Manhattan Beach Blvd, Manhattan Beach, CA 90266. **See at Booth P8138** **Circle 306**

NOTE: "A" series booths are located in Anaheim Convention Center's Arena, "N" series in the North Hall, "S" series in the South Hall, and "W" series in the Southwest Hall. "P" series booths are in the NCC Pavilions adjacent to the Registration area. "D" series booths are located in the Disneyland Hotel Convention Center. Shuttle buses will run between the two exhibit locations and all convention hotels.

IMAGIN.™

An array processor and raster display in one complete imaging system.

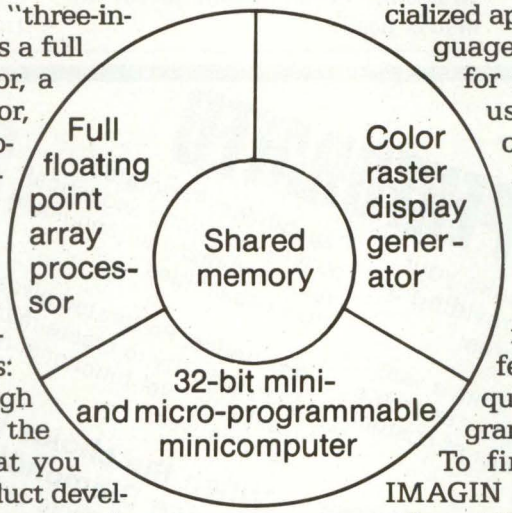


CDA's IMAGIN™ system, networked and VAX*-based for highest performance, makes fast and simple imaging a reality.

You'll benefit from a unique "three-in-one" design that incorporates a full floating point array processor, a color raster display generator, and a 32-bit mini- and micro-programmable minicomputer in one compact chassis. What's more, the system also features a shared memory, which significantly eases user programming. Other advantages:

Time, money savings. The high level interactive language of the IMAGIN system offers what you need in order to shorten product development time. You can get your product to market faster and significantly reduce R&D costs.

Simplicity. Just plug the IMAGIN system directly into your VAX,* LSI* or PDP* computer. You can operate the IMAGIN system right from your desk. Waiting time is virtually eliminated because multiple IMAGIN systems network onto a simple timesharing system.



Versatility. IMAGIN software will assist you in the development of new routines at your site. You can customize microcode routines for specialized applications in a variety of languages, including FORTRAN. Or, for immediate start-up, you can use the IMAGIN interactive commands.

Memory. The IMAGIN system's five-ported memory gives you convenient access to the array and display processors, I/O port, VAX, and micro-minicomputer. This feature minimizes coding requirements and shortens program run times.

To find out more on how our IMAGIN system can best work for you, call us at (617) 647-1900 or write:

CDA COMPUTER DESIGN & APPLICATIONS INC.

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CIRCLE 81

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Some companies exhibiting at NCC '83 were not able to release advance information on their "Product Firsts" by press time. Others will be showing products that were announced previously and described in recent issues of *Computer Design*. Briefs on the following pages summarize what to expect on the exhibition floor this year.

Able Computer, Irvine, Calif **(Booth W6334)**—DMA line printer controller VMZ/LP offers performance improvements in VAX-11 systems and compatibility with VAX/VMS version 3.X.

Alien Group, New York, NY **(Booth D407)**—A speech synthesizer produces song; the Sprinter offers fast and slow scroll to a monitor as well as buffering capability.

Alpha Data Inc, Chatsworth, Calif **(Booth S5031)**—Memory products include Atlas disk memory, M/Core core memory, and model 80 head/track magnetic disk memory.

Altos Computer Systems, San Jose, Calif **(Booth W6218)**—ACS 586 family 16-bit microcomputers accommodate from 5 to 8 users and incorporate networking capability.

Amco Engineering Co, Schiller Park, Ill **(Booth W6588)**—Computer related furniture includes line of enclosures and workstations, computer desks, and cabinets.

Amperex Electronic Corp, Hicksville, NY **(Booth P7500)**—GP300 letter quality printers produce 18 x n characters in a single pass using an 18-needle (9 x 9) interlaced dot matrix head.

Ampex Corp, Redwood City, Calif **(Booth N3500)**—D150 and D175 editing VDTs are equipped with an onboard 32K-bit EPROM socket that allows firmware modification.

Analog & Digital Peripherals, Inc, Troy, Ohio **(Booth S5600)**—Magnetic peripherals encompass 200k-byte minicassettes and 250k-byte minicartridges as well as 1M-byte floppy disk subsystem, 12M-byte cartridge system, and bar code readers.

Applied Magnetics Corp, Goleta, Calif **(Booth N3648)**—Magnetic recording heads made using thin film techniques provide high density recording on disks and tapes.

Archive Corp, Costa Mesa, Calif **(Booth D2215)**—Mass storage peripherals providing backup for disk subsystems include Sidewinder and Super Sidewinder 20M- and 45M-byte streaming magnetic cartridge tape subsystems.

When the problem is design flexibility . . .

THE CHOICE IS PERFORATED

Perforated materials can make your design ideas a reality by providing a number of important features:

Tooling: Specify from a vast standard tool list — or create an infinite number of custom patterns.

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custom perforators of ferrous and non-ferrous metals and a variety of other raw materials. We proudly offer these important services:

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DIAMOND MANUFACTURING COMPANY and LONE STAR PERFORATING COMPANY
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CIRCLE 82

THE BOX



VERSATILITY? How many microcomputers can you name that you can change from 8-Bit to 16-Bit in 2 minutes? Probably not many. But this is exactly what can be done with the **"The Box"**.

Our current unit is Z80B, CP/M™ based, all that is required to change to a 16 Bit microcomputer is to remove the Z80B card set and replace it with our new 8086 card set and you have your 16-Bit microcomputer. We even give you an option of operating systems; CP/M-86,™ Concurrent CP/M-86™, or MSDOS.™

Some of the standard features you will find on **"The Box"** are; EPROM and E²PROM Programmer, 2 8" double density, double sided floppy disks, 4 RS232 ports, and Centronics Printer Port. Some of the options include; 20 or 40 MByte hard disk, full function GP-IB controller, 8" and 5¼" floppy disks, up to 1 MBYTE bank memory module, etc...

In October we will have a 68000 card set for **"The Box"** that will run on a UNIX™ based operating system.

So, if you want versatility and expandability, **"The Box"** is what you need. Call us on our Toll Free line for complete information.

CP/M, CP/M-86, Concurrent CP/M-86 is a trademark of Digital Research Inc.
Unix is a trademark of Bell Labs. MSDOS is a trademark of Microsoft.

Zax Corporation

ZAX

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Westminster, California 92683
Toll Free 1-800-421-0982
CA, HA, AK 714-898-2373

CIRCLE 42

Arthur Andersen & Co, Chicago, Ill **(Booth D104)**—MAC-PAC/38 supplies integrated online manufacturing resource planning and control; METHOD/1 offers a project management and systems development methodology.

C & D Batteries, Plymouth Meeting, Pa **(Booth D1406)**—Lead-calcium batteries for uninterruptible power systems feature 2-hole posts with copper inserts for greater conductivity, contact, and safety, and provide a wide range of voltages.

Canon U.S.A., Inc, Lake Success, NY **(Booth P7626)**—7-color ink jet printer A-1210 produces 40 cps with 640-dot/line resolution on plain paper; A-1200 outputs 120 cps using bidirectional dot matrix impact techniques.

Home Sweet Home for Your Multibus*

Finally there's a system chassis that is designed and manufactured with the thoroughness and care you expect in your Multibus system. It's Electronic Solutions' new Multichassis™.

- **9 slots, 0.6″ spacing—or 7 slots, 0.75″ spacing**
- **Hefty 4-output 300W power supply— 40A at +5V**
- **Cool operation even with high-density boards**

There's a field-proven card cage and backplane, plus full RFI filtering, locking front panel function switch, power fail detection, and quiet dual cooling fans with quick-change filters.

And best of all, the removable front panel lets you easily customize the Multichassis to match your company color and logo.

So treat your Multibus system to an elegant but affordable new home—the Multichassis by Electronic Solutions. Call us today for full specifications and prices.

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San Diego, CA 92138
Call Toll Free
(800) 854-7086
In California (619) 292-0242
In Canada call:
Transduction Ltd.(416) 625-1907



*Multibus is a Trademark of Intel. Corp.

Computer Products Corp, Plymouth, Minn **(Booth D2046)**—Multibus compatible controllers and adapters handle Winchester disks, as well as ½″ and ¼″ streaming and start/stop tape drives.

Cyb Systems, Inc, Austin, Tex **(Booth P8029)**—Incremental configuration of distributive computing systems offers high speed transfer including remote terminal access and log-in through local area networks using Berkeley protocol and Ethernet hardware.

Data Devices International, Chatsworth, Calif **(Booth N4500)**—A magnetic computer tape machine, Minicertifier identifies defects, places them in a microscope repair station, and permits their repair.

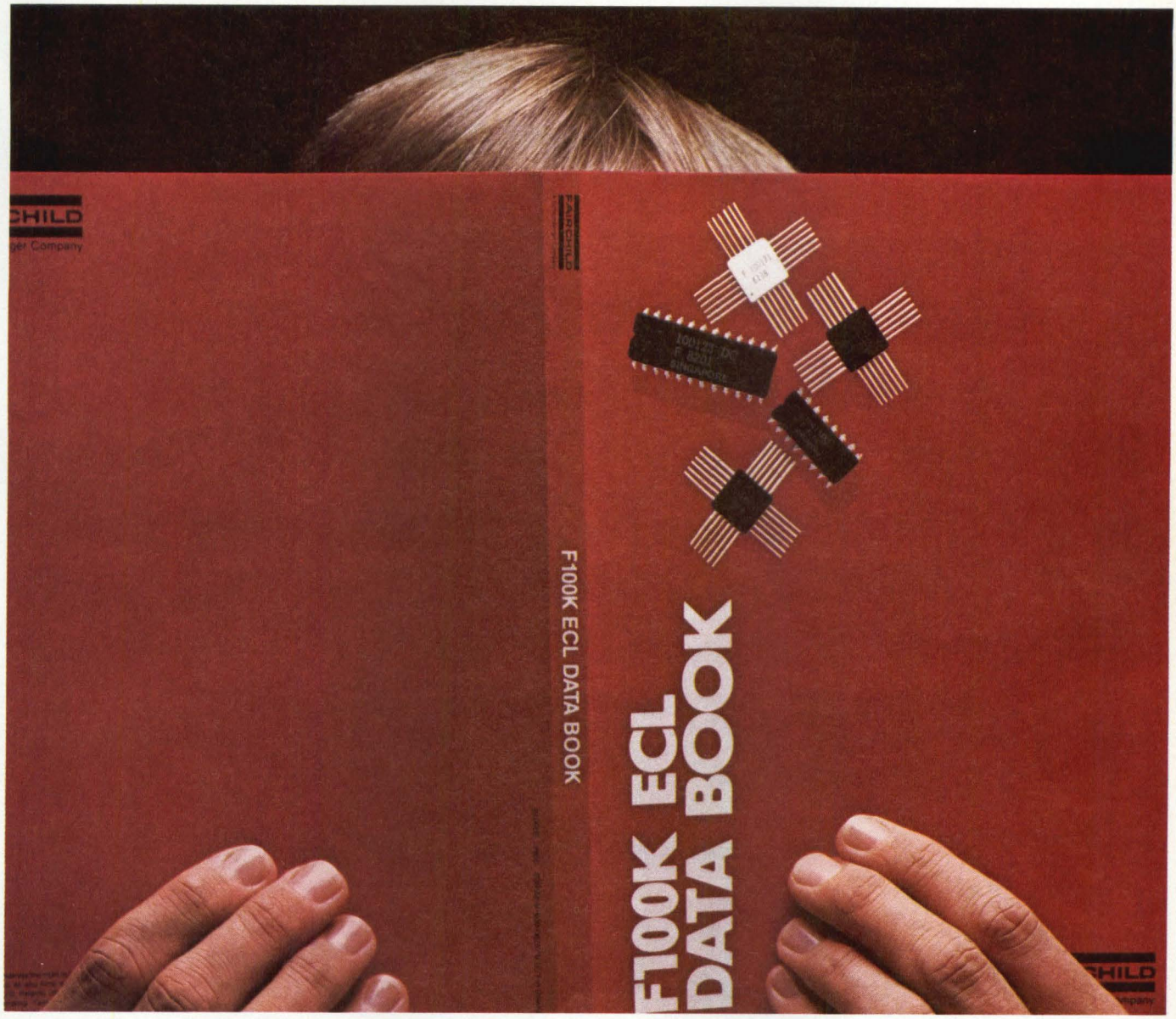
Data Magnetics Co, Santa Clara, Calif **(Booth P7744)**—9-track magnetic read/write heads handle double-density phase encoded recording for streaming tape drives at up to 125 ips.

Datamedia Corp, Pennsauken, NJ **(Booth W6040)**—Super-microcomputer 932 uses Pick operating system to support up to 16 users with from 256K bytes to 1.5M bytes of main memory and up to 30M bytes of Winchester disk storage.

Dataproducts Corp, Woodland Hills, Calif **(Booth N3938)**—DP-35 and DP-55 daisy wheel printers produce output at 35 and 55 cps, respectively; a 90° tilting printhead mechanism allows easy printwheel changes.

FAIRCHILD

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In high-performance applications, if you want speed, you have to go F100K. If you want F100K, you have to go Fairchild. And if you really want to do it right, you have to go by the book. The F100K ECL Data Book.

It's filled with all kinds of incredible specs. Did you know we have a complete logic family of 38 devices with 4 new ones planned for 1983? Did you know we've got logic internal gate delays of 750 ps—with all parts available in both DIPs and Flatpaks?

There's more. There's voltage and temperature compensation for ease of use. And delivery times almost as fast as the parts themselves.

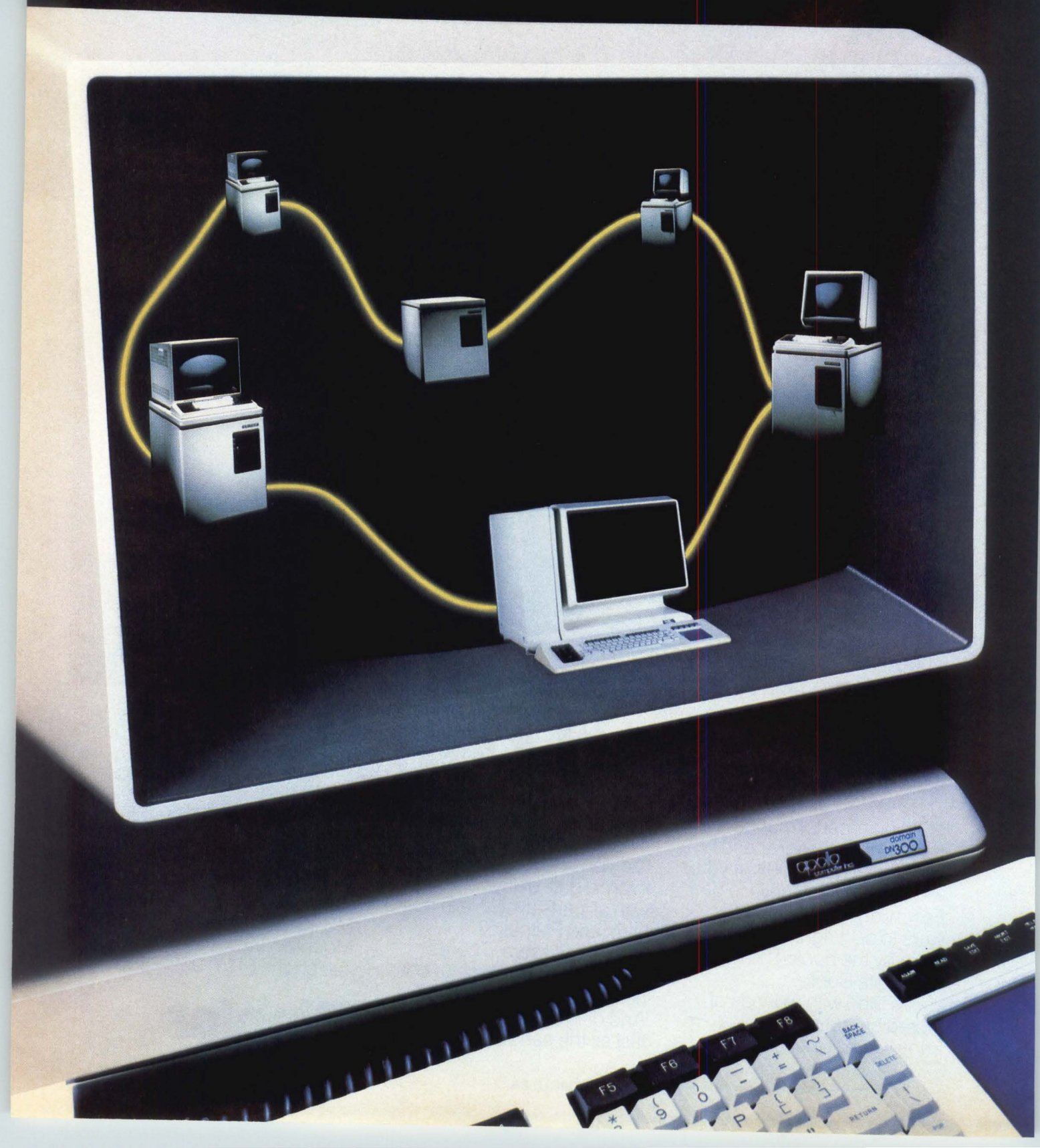
F100K. For sizzling reading, just call or write Fairchild Advanced Bipolar and request the F100K Data Book or User's Handbook. 441 Whisman Rd., MS 23-1250, Drawer #7283, Mountain View, CA 94039. Telephone (415) 962-2356.

Bipolar

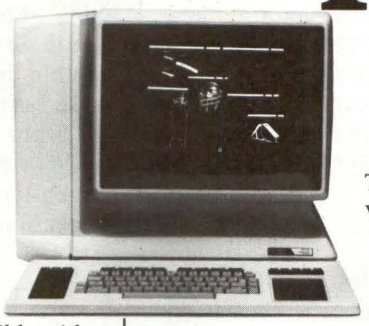
Fairchild Camera and Instrument Corporation

CIRCLE 84

Introducing:



the $10,000 desktop mainframe.



THE NEW APOLLO DN300 WILL COMPLETELY CHANGE THE WAY TECHNICAL PROFESSIONALS USE COMPUTERS.

The DN300 is quite possibly the single most important computer system ever introduced for the technical professional. For the first time ever, these technical professionals have fingertip access to a desktop mainframe, and all the power that goes with it. The power to utilize time in the most efficient possible way. The power to increase technical productivity and innovation. The power to try out and refine new ideas and concepts. The power to reduce design-time cycles. The power to create better, more cost-effective products.

In a unit that takes no more space than a daily newspaper, the DN300 gives you a high performance, 32-bit virtual memory processor, high resolution bit map graphics, and an integrated local area network that provides network-wide virtual memory access.

The DN300, latest in the family of DOMAIN processing nodes, supports up to 1.5 million bytes of main memory and 15 concurrent processes of 16 million bytes each, so you can execute large programs. Its 17-inch 1024 x 800 pixel landscape display provides the high-resolution graphics you need for technical applications. The 12 million bit-per-second high speed token-passing network lets you access data anywhere in the network without sacrificing performance.

The DN300 is fully compatible with Apollo's DN400, 420, and 600 and supports multiprogramming environment, large virtual address space, network communications, multi-window display management, and extensive command library.

SOFTWARE YOU NEVER THOUGHT YOU'D SEE ON YOUR DESKTOP.

Standard with every DN300 is AEGIS, the only network-wide virtual memory operating system available.

Optional software includes ANSI-FORTRAN 77, Pascal, C, SIGGRAPH Core Graphics, X.25, HASP, 3270, D3M distributed database system and AUX, a software environment based on UNIX™ System III.

NEW DOMAIN SERVER PROCESSOR—A LOW COST WAY TO HANDLE NETWORK PERIPHERALS AND GATEWAYS.

The new DSP80 intelligent peripheral server lets DOMAIN users freely share the same, centrally located peripherals. That relieves individual nodes of peripheral support. So nodes have more time and more power to handle application-related computing.

And you save money by sharing disks, tape drives, printers and plotters. The DSP80 also provides every user with access to communication gateways, large-scale file storage, and print/plot spooling.

FIND OUT MORE

The DOMAIN network gives you low entry cost, high performance, easy and natural incremental growth, reliability, and long-term investment protection. And it gives your technical staff the excitement and satisfaction of working with an innovative, highly productive new tool. For more information call Apollo's marketing department at (617) 256-6600, extension 608, or write Apollo Computer Inc., 15 Elizabeth Drive, Chelmsford, MA 01824.

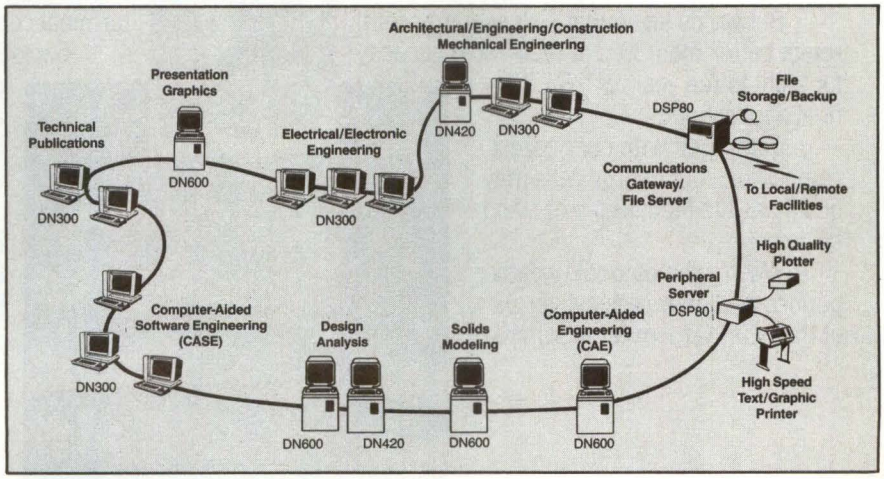
UNIX is a trademark of Bell Laboratories.

USA price $9,933, system builder, quantity 35 DN300 with .5Mb memory, 17-inch graphics display, network interface, and AEGIS operating system.

A DOMAIN professional productivity network puts an application specific mainframe on every user's desktop.

The truly exciting aspect of a DOMAIN network is its ideal combination of individual initiative and teamwork. Users get not only the benefits of a high performance, 32-bit computer dedicated to their application, but also retain the benefit of shared resources.

For example, use the color DN600 or monochromatic DN420 nodes for solids modeling, VLSI CAD, finite element analysis, pre- and post-processing, and image analysis. . . . Use the DN300 for computer-aided software engineering, design documentation, high-quality presentation graphics, drafting, and electrical design capture and simulation.



apollo computer inc.

Domain: The Next Generation

See us at NCC #A3208

CIRCLE 85

Data Type, Inc, Mountain View, Calif **(Booth P7758)**—Color and Tektronix compatible graphics terminal line has been extended to include AutoGraph XK2, which adds features and a larger tube to the XK1 series.

Digi-Data Corp, Jessup, Md **(Booth N4004)**—Series 8300 ¼" cartridge tape drives come in both unidirectional and serpentine head versions for recording and reading IMFM data serially on 4 tracks at 8333 bpi, 37.5 ips in both start/stop and streaming modes.

Esprit Systems, Inc, Hazeltine Terminals Div, Commack, NY **(Booth W6288)**—Video display terminal Executive 10/78, an alternative to the IBM 3278, offers low profile keyboard and IBM SNA compatibility. Esprit III Color supplies 8 colors in 2 intensities on a 14" (36 cm) screen.

Exide Electronics, Raleigh, NC **(Booth S5556)**—Series 2000 uninterruptible power supply has single-phase ratings from 15 kW to 30 kW and 3-phase ratings from 15 kW to 45 kW; electronics and maintenance-free batteries are housed in 3 side by side cabinets.

Facit/Dataroyal Div, Nashua, NH **(Booth N3538)**—Model 4512 produces correspondence quality characters in 2 passes and prints 120 cps single pass in 132 cols; heavy duty 4542 and 4-color 4544 Flexhammer printers include bottom feed paper handling.

Florida Data Corp, Melbourne, Fla **(Booth N4700)**—Printer model OSP125 is especially designed to handle word processing applications.

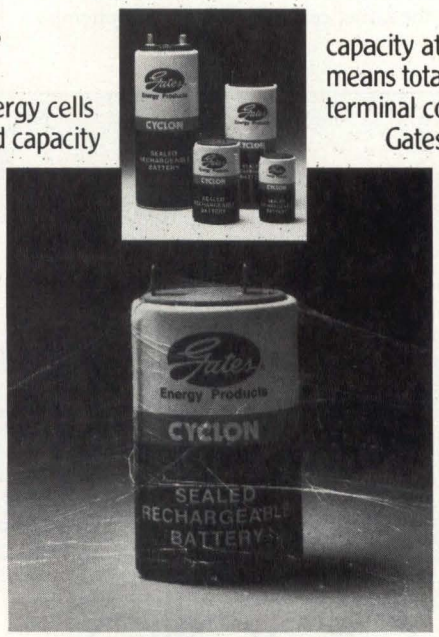
Formation, Inc, Mt Laurel, NJ **(Booth P7112)**—Failsoft F/4000 provides program compatibility with IBM System/370 mainframes and limits downtime caused by component failure to 5 min.

Fujitsu Microelectronics, Inc, Santa Clara, Calif **(Booth W6478)**—Micro 16s business computer integrates 2 microprocessors running under the CP/M-86 operating system and incorporates two 5¼" floppy disks and 128K bytes of RAM.

Gould Inc, Distributed Systems Div, Ft Lauderdale, Fla **(Booth W6058)**—Compatible family of 5 modular UNIX based computers range from desktop model to mainframe and interconnect over local area network.

Just how long should standby power stand by?

Five years? Ten years? Twenty?
Quite frankly, we don't know.
But we do know that Gates Energy cells retain better than 80% of their rated capacity for eight to ten years at 23°C. in float applications.
Compared with our nearest competitors, our energy cells may qualify as the Methuselah of standby power.
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Gates Energy cells are rated at 2 volts with capacities at 2.5 Ah, 5 Ah, 12.5 Ah and 25 Ah. They can be assembled into an endless variety of configurations.
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GATES ENERGY

CIRCLE 86

THE BUS STOCKS HERE:

PSM-512A: 512 kbyte Multibus™ memory with ECC, 275 nsec access time. Fixes single-bit errors, flags multi-bit errors.

CIRCLE 87

PSM-512P: 512 kbyte Multibus parity memory, 240 nsec access time. Very economical.

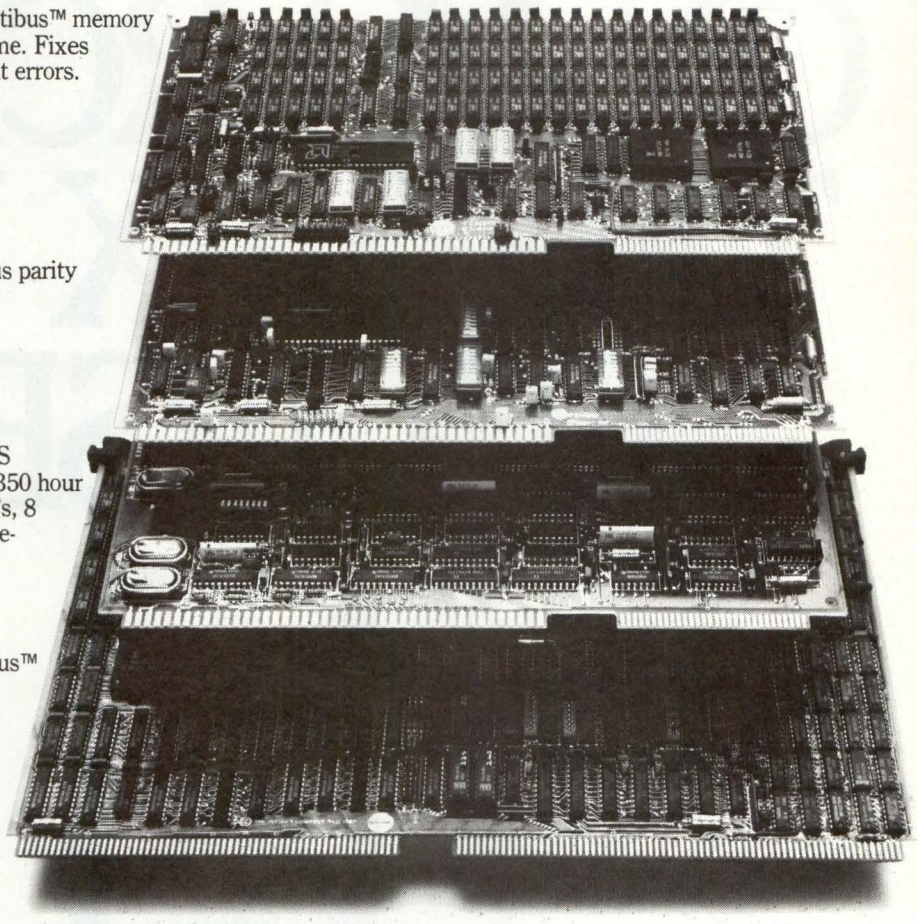
CIRCLE 88

PSM6463: 64 kbyte non-volatile CMOS Multibus memory, 200 nsec access time. 350 hour standby with on-board rechargeable NiCd's, 8 years with lithium. For process control, telecommunications, other critical applications.

CIRCLE 89

NEW PSM1VA: 1 megabyte VERSAbus™ memory with ECC, 300 nsec access time. Lots faster and much less expensive than Motorola and IBM equivalents. Full 32-bit VERSAbus compatibility.

CIRCLE 90



If you're on board the Multibus or VERSAbus, we've got the memories you need to get where you're going faster, for less. ECC, parity and non-volatile CMOS. All in stock now, all with one thing in common. Their first name is Plessey.

And since Plessey makes them all, they all have high reliability, a one year warranty and Plessey support worldwide.

For more information, just contact Plessey Microsystems, 451 Hungerford Drive, Rockville, MD 20850. (301) 279-2892, TWX 710-828-9815. Irvine, CA: (714) 540-9931.

In Europe, contact: Towcester, UK: (0327)50312, Telex 31628. Paris: 776 41 06. Noordwijk: (01719) 19207. Munich: (089)2362226. Rome: (06) 350189.

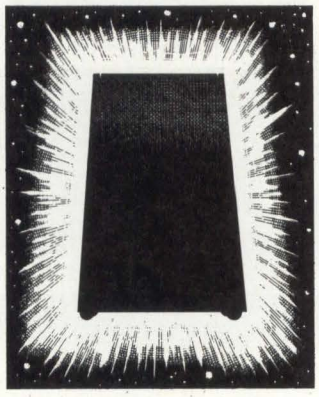
Or get on board fast by calling (800) 368-2738 today. Your bus ought to be going our way.

PLESSEY

Multibus is a trademark of Intel
VERSAbus is a trademark of Motorola

See us at NCC #A3208

AT 11 A.M. ON MARCH 2ND, THE VAX™ WAS ECLIPSED.

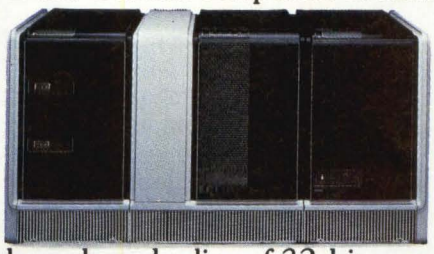


If you decided to buy a computer system before 11 A.M., March 2nd, it was possible to make a purchase decision without fully considering Data General.

But on that date, the world changed.

At 11 A.M., we introduced the most powerful 32-bit virtual supermini ever produced by a computer company. Our Eclipse™ MV/10000.

Yet the Eclipse MV/10000 is only the most recent in a series of steps we have taken to make Data General computers overshadow Digital's entire line of VAX computers.



So now, if you do a full evaluation of computer systems, the VAX no longer comes out ahead.

PERFORMANCE. The Eclipse MV/10000 executes 2500 kwets/sec. And transfers I/O at 28.6 mb/sec. The VAX 11/780 executes* 1200 kwets/sec. And transfers I/O at 13.3 mb/sec. A comparison that's no comparison.

RANGE. With the Eclipse MV/10000, Data General has a broader line of 32-bit computer capability than Digital. Which means a Data General computer will better fit your exact needs. Whatever those needs may be.

PRICE. When you compare Data General Eclipse MV computers against Digital's VAX computers on the basis of price,* you get a very interesting perspective. The Eclipse MV/10000 has the same price as the VAX 11/780, but twice the performance. And the recently announced Eclipse MV/4000 has twice the performance of a VAX 11/730 at the same price.

COMPATIBILITY. We at Data General have made it a top priority to make our system's software and I/O compatible. So if your needs ever change, you can take your investment in software and peripherals onto other Data General computers. Which is something you can't do with Digital's VAX computers.

GRAPHICS. Also, we fully support our own color graphics terminals, high resolution color workstations, color graphics controllers and standard GKS software. All of which make the job of integrating your total application considerably easier.

SOFTWARE. Data General has the full range of systems software you'll need for whatever you need to do. Including a 32-bit Real Time Operating System. (Something else Digital doesn't have.)



Our systems software covers a wide range of applications – including Data Communications, Networking, Time-Sharing and Office Automation. Plus all the standard development languages. All to industry standards. And third-party applications software for mechanical, electrical and architectural engineering; imaging and process control.

SUPPORT. We do more than make computers today. We work with you to make your projects succeed. By going out of our way to be both accessible and helpful. With things like marketing support, a national phone center and remote diagnostics. In fact, we're offering uptime guarantees of up to 99%.

So when you look at where Data General is today – and where the competition is today – the VAX has been ECLIPSED.

For additional information contact Don McDougall, Director, Technical Products, M.S. F134, Data General Corporation, 4400 Computer Drive, Westboro, MA (617) 366-8911.

Data General

See us at NCC Booth #S5174

*Sources include trade press articles, Digital literature, industry reporting publications and data supplied by industry reporting services.

CIRCLE 91

Gould Inc, Electronic Power Conversion Div, San Diego, Calif **(Booth W6058)**—Online 45-kVA uninterruptible power system model 6456 has digital information system that provides power status information to computer via RS-232-C interface.

Grid Systems Corp, Mountain View, Calif **(Booth D0132)**—Personal portable Compass computer system, Compass Central, and Grid Central service form building blocks of Navigator management decision support system.

Harris Corp, Information Systems, Melbourne, Fla **(Booth S5062)**—9000 series family office systems range from standalone to clustered configurations that integrate word processing, personal computing, and communications capabilities as well as data processing via network connections.

Houston Instruments, div of Bausch & Lomb, Austin, Tex **(Booth N3810)**—DMP-41 plots a 20″ x 32″ (51- x 81-cm) area for CAD systems; DMP-40 plots a 11″ x 17″ (28- x 43-cm) area at 4.2 ips using a single pen; and the DMP-29 is an 8-pen 11″ x 17″ plotter that prints at 22 ips.

Infotron Systems Corp, Cherry Hill, NJ **(Booth D1410)**—SM380, SM480, and 600 series statistical multiplexers, 790 network concentrator, and IS4000 intelligent switching system reduce line costs and increase control of global or local area network.

Innovative Electronics, Inc, Miami, Fla **(Booth S5049)**—Self-contained MC-80 protocol converters allow independent terminals to be connected to most IBM, Burroughs, and NCR computers; MC-80/600, a BSC emulator, microprocessor based controller connects IBM 3270 BSC and asynchronous ASCII device.

Input-ez Corp, Englewood, Colo **(Booth P7406)**—CRT terminal stands and workstations incorporate a retractable keyboard feature that eliminates unnecessary head and eye movement.

International Memory Products of Calif, Inc, Santa Monica, Calif **(Booth P8108)**—Magnetic media, printer supplies, computer support systems, and computer related furniture are offered along with disk pack refurbishing and recertifying services.

ISSCO Graphics, San Diego, Calif **(Booth S5374)**—DISSPLA® computer graphics software provides 3-D surfaces, mapping, and contouring; TELL-A-GRAF®, an English language conversational program, generates line, bar, pie, and word charts.

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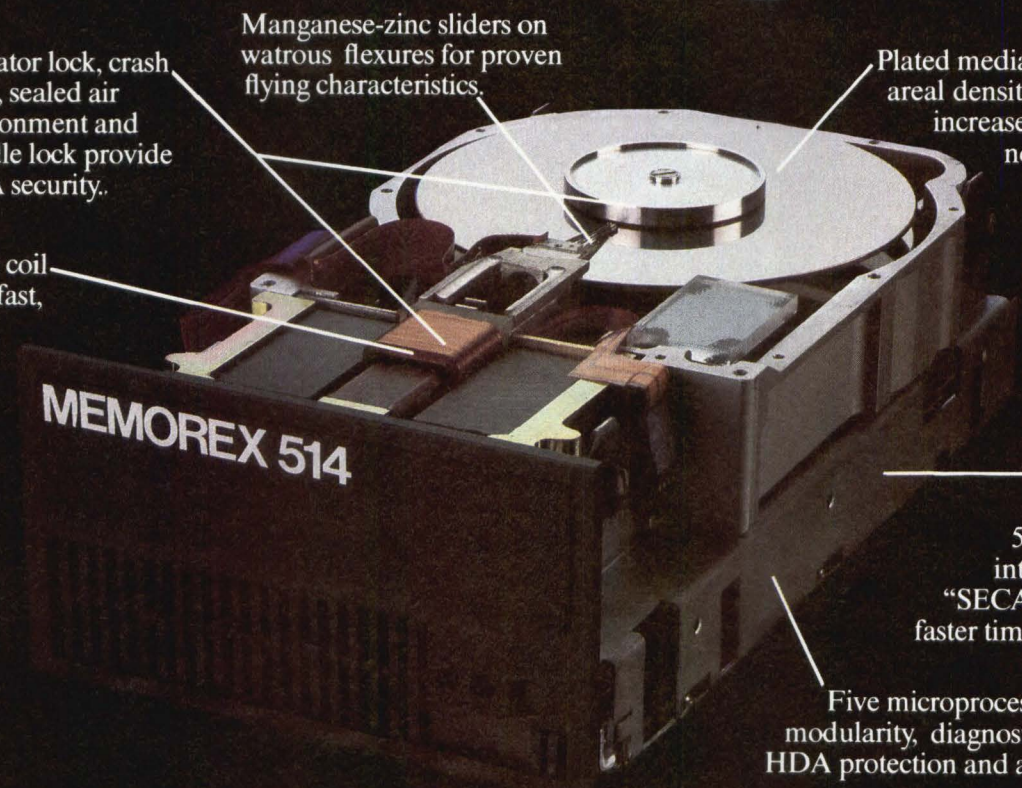
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CIRCLE 92

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CIRCLE 94

KMW Systems Corp, Austin, Tex **(Booth N3968)**—VP-30 series vector processors reduce random vectors, symbols, and graphic information from a host computer to raster form and output it to an attached electrostatic plotter; series II protocol converters use IBM binary synchronous protocol to transmit and receive EBCDIC data.

Lee Data Corp, Minneapolis, Minn **(Booth P7655)**—Controllers, printers, and personal workstations and displays provide IBM 3270 compatibility.

Lortec Power Systems, Inc, N Ridgeville, Ohio **(Booth N3529)**—Uninterruptible power systems supply power in the 2- to 156.25-kVA range.

3M Co, St Paul, Minn **(Booth N3956)**—Magnetic media and memory subsystems include disk and tape media as well as compact Winchester disk and magnetic tape cartridge drives.

M/A-COM DCC Inc, Germantown, Md **(Booth N4708)**—CP9000 communications processor supplies high performance for online realtime use; data communications terminal, statistical multiplexers, and integral modems provide economical use of facilities.

MAI/BASIC Four, Tustin, Calif **(Booth W6096)**—Information System 810 and the S/10 microcomputer offer entry level and larger systems to small- and medium-sized businesses.

MFE Corp, Salem, NH **(Booth 6296)**—Double-capacity 20M-byte magnetic tape transport and SASI QIC II controller supply backup for 5¼" disk units.

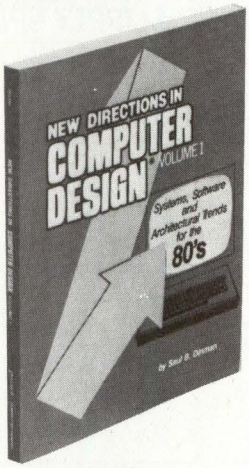
Microscience International Corp, Mountain View, Calif **(Villa Suites at Disneyland Hotel)**—HH-612 achieves 18M bytes of capacity on a 5¼" hard disk using 2 of 7 coding; dual microprocessors ensure accurate tracking, rapid access, and precise velocity control.

Momentum Computer Systems International, Sunnyvale, Calif **(Booth D200)**—The 32-bit model 32 microcomputer supplies up to 1M-byte main memory, no-wait state memory management, and UNIX operating system; model 32E supplies 512k bytes memory, DMA controller, and optional SMD controller.

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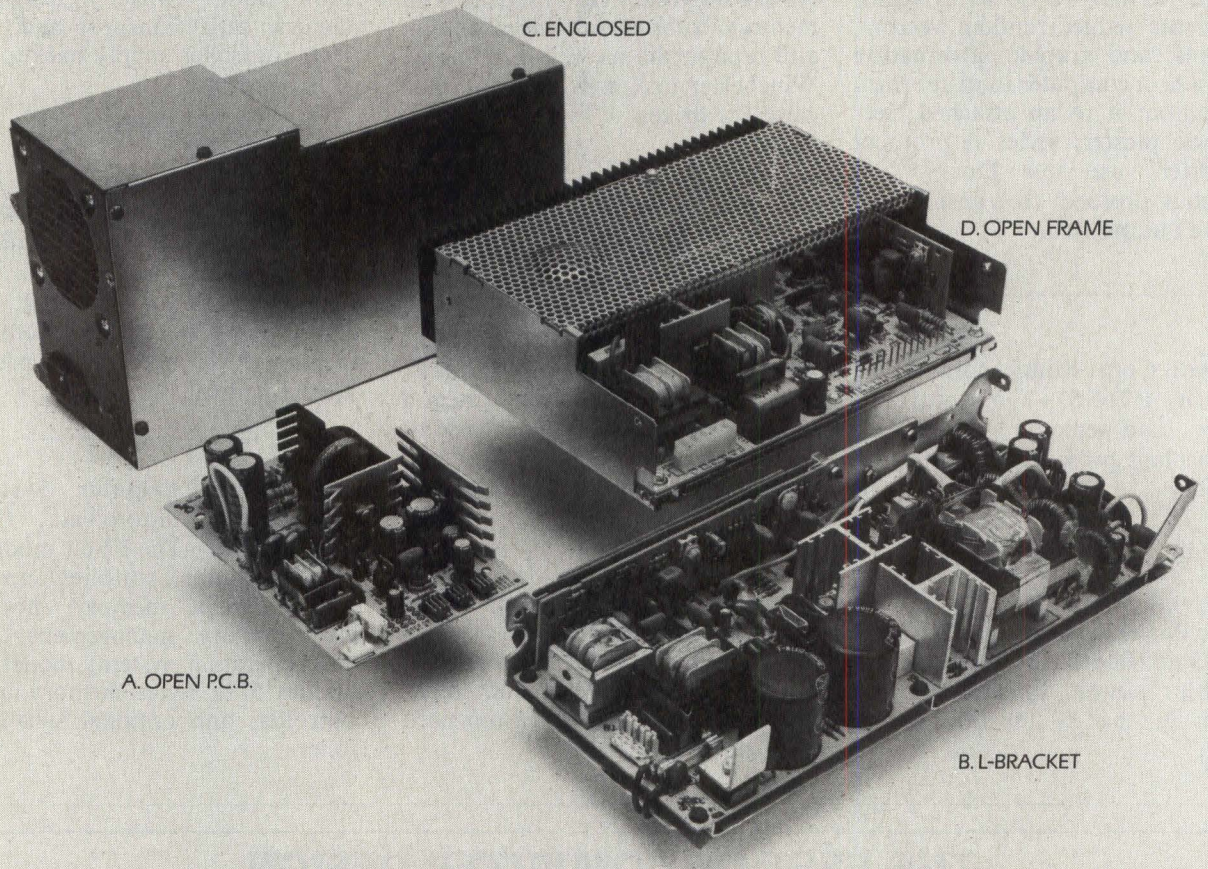
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MODEL	MAX OUTPUT (WATTS)	OUTPUT LOAD CURRENT						COOLING	FIGURE	DIMENSIONS L x W x H (INCHES)
		+5 V MIN/MAX (AMPS)	−5 V MIN/MAX (AMPS)	+12 V MIN/MAX (AMPS)	−12 V MIN/MAX (AMPS)	+12 V REG MIN/MAX (AMPS)	OTHER MIN/MAX (AMPS)			
Z-42-DF	42	.5/2.5	—	.3/2	.04/.5	—	—	Convection	A	6.3 x 3.9 x 1.8
Z-42-EB	42	1/5	—	.7/1.3	.02/.1	—	—	Convection	B	7.3 x 3.9 x 2.0
Z-43-J	43	1.4/4	0/.1	—	—	—	+15 V @ .7/1.5	Convection	A	8.3 x 5.5 x 2.5
Z-64-C	64	2.5/7	0/.3	.5/2	0/.2	—	—	Forced Air	A	9.5 x 5.5 x 4.8
Z-65-DG	65	1/5	—	.3/2	0/.2	0/1.5	—	Convection	B	8.3 x 4.3 x 2.3
Z-73-BA	73	.5/5	—	0/2	0/2	—	—	Convection	C	12.2 x 5.8 x 2.0
Z-74-CA	74	3/6	—	.3/2	0/.2	0/1.5	—	Convection	A	8.5 x 5.0 x 2.0
Z-128-CH	128	1/15	0/.2	.15/1	—	—	+32 V @ 1/1.25	Convection	D	7.5 x 9.4 x 4.0
Z-218-BC	218	10/28	—	.6/4	0/1	0/1.5	—	Forced Air	B	11.8 x 4.8 x 2.5
Z-240-BD	240	2/12	—	4/5.2	—	.5/1.5	+8 V @ .15/8 +16 V @ 0/1 −16 V @ 0/1	Forced Air*	C	11.3 x 5.7 x 6.5
Z-240-CB										11.4 x 4.2 x 6.6
Z-352-BG	352	1.6/8	—	4/2	—	—	+27.5 V @ .25/4.8 −27.5 V @ .25/3.5 +170 V @ 0/.5	Convection	A	11.5 x 11.5 x 4
Z-9-ED	9	—	—	—	—	—	+18 kV @ 20/500 mA	Convection	C	5.5 x 4.4 x 2.5

*DC Fan Included/Specifications and Availability Subject to Change Without Notice.

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CIRCLE 95

MPI, Salt Lake City, Utah **(Booth A3309)**—Dot matrix printers PrintMate 99, PrintMate 150, and AP PAKs supply high speed, correspondence quality output or graphics capability.

Nixdorf Computer Corp, Waltham, Mass **(Booth W6100)**—DPEX II and III, versions of the Distributed Processing Executive Operating System, provide added data entry, management, and editing language features; communications features now include dual communications and extended 3270 capabilities.

Okidata Corp, Mt Laurel, NJ **(Booth W6140)**—Microline dot matrix printers offer 80 to 120 cps in 80 to 132 cols using the ASCII 96-char set; Pacemark models produce 350 cps, printing bidirectionally with short line seeking logic.

OSM Computer Corp, Mountain View, Calif (Suite at Holiday Inn)—Zeus Multiprocessor systems support multiple users simultaneously in a CP/M compatible operating environment; MUSE operating system provides file management and data security functions.

Perkin-Elmer Corp, Oceanport, NJ **(Booth N3516)**—32-bit 3200 series minicomputers support multiple users and multiple tasks; packaged systems include commercial and turnkey CAD/CAM systems.

Plexus Computers, Inc, Santa Clara, Calif **(Booth S5384)**—UNIX based supermicrocomputers, linked in an Ethernet local area network through the Network Operating System, can access files and devices on other systems in the network.

Prentice Corp, Sunnyvale, Calif **(Booth D2126)**—Model 212 terminal controlled modem and model 212, 201C trimodem, and SNP 1100 and 1200 statistical multiplexers fill users' communications needs.

Priam Corp, San Jose, Calif **(Booth N4808)**—3M-, 70M-, and 105M-byte capacity are supplied by 8″ Winchester drives; intelligent SMART, SMART-E, and SMART-T interfaces handle up to 4 Winchesters and ¼″ and ½″ cartridge tape subsystems.

PrintaColor Corp, Norcross, Ga **(Booth D2133)**—TC-1040 ink jet printer produces 4900 hues on plain paper at speeds of 108 raster-inches/s; user loadable lookup tables specify colors in format compatible with many graphic computers.

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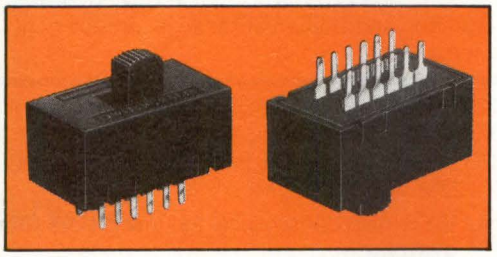
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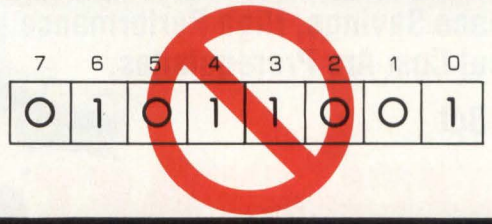
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Racal-Vadic, Sunnyvale, Calif **(Booth W6848)**—Scotsman statistical multiplexers and data compressors allow a 19.2k-bps data stream to be transmitted over 9600-bps modems, and a 9600-bps data stream to be transmitted over 4800-bps modems.

Rockwell International, Newport Beach, Calif **(Booth S5200)**—AIM 65 microcomputer with memory cartridges will be displayed along with the RM 65 microcomputer driving AIM 65/40 Series 8000 printer and display; AIM 65 demonstrates the R24DC modem.



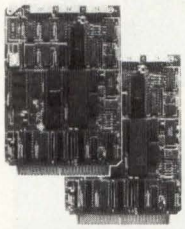
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Sakata U.S.A. Corp, Elk Grove Village, Ill **(Booth D2000)**—Display monitors include both monochrome and color CRTs for use in video display terminal systems.

Shugart Associates, Sunnyvale, Calif **(Booth N3856)**—Fixed and removable storage needs are filled by SA410/460 double- and single-sided, 96-tpi, 5¼" floppy drives, SA600 5¼" Winchester drives, and SA300 3½" single-sided microfloppy drives.

Solid State Controls, Inc, Columbus, Ohio **(Booth P7431)**—Powerbase 2000 uninterruptible power supply system maintains constant flow of power to computer systems.

Sony Microcomputer Products, Montvale, NJ **(Booth P7038)**—SMC-70 personal microcomputer adds power with 16-bit Supercharger; color monitor, printer, Corvus hard disk, and microfloppy disk drives are among the system's peripheral devices.

Sydis, Inc, San Jose, Calif **(Suite at Anaheim International Hotel)**—Colleague integrates voice, data, text, and graphics into a compact executive workstation that can be configured into clusters or connected through telephone lines using a high speed network.

Tandem Computers, Inc, Cupertino, Calif **(Booth W6078)**—Time staged transfer information delivery system allows strategic deployment of data throughout a single system or a network of distributed NonStop computer systems.

TDK Electronics Corp, Port Washington, NY **(Booth P7700)**—M2DX-S diskettes supply 96-tpi density on double-sided 5¼" media with a hub ring for durability.

TEAC Corp of America, Montebello, Calif **(Booth P7234)**—FD-55 series 5¼" floppy disk drives supply single- or double-density, single- or double-sided recording in a half-height form factor.



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CIRCLE 98

Trilog Inc, Irvine, Calif **(Booth A3109)**—TIP-300 dual- and TIP-150 single-hammerbank, dot-matrix impact line printers operate at 300 and 150 lps, respectively, with built-in graphics plotting capability; dual version offers continued operation of one hammerbank at half speed should the other fail.

Universal Data Inc, Clarkston, Mich **(Booth D1301)**—UDI-100, a general purpose handheld terminal, allows users to initiate programs through the keyboard using 2-way RS-232 communications at 300 to 1200 baud.

Universal Data Systems, Huntsville, Ala **(Booth S5218)**—Limited distance modems operate over distances up to 23 mi at 19.2k bps; statistical time division multiplexers provide from 2 to 8 channels with speeds of from 2400 to 19.2k bps.

Video Monitors, Inc, Eau Claire, Wis **(Booth P7417)**—C1000 color monitor supplies graphics resolution with 0.31-mm precision and image linearity of 1% on 19″ (48-cm) CRT.

Wabash DataTech Inc, Des Plaines, Ill **(Booth N3570)**—Enscribe diskette duplication service copies and verifies data onto 5¼″ or 8″ diskettes complying with ANSI, ECMA, and ISO standards.

Western Digital Corp, Irvine, Calif **(Booth S1810)**—ST500/SA1000 compatible WD1002 puts both Winchester and floppy disk drive controllers on a single board that mounts on top of a 5¼″ drive by using single-chip controllers along with error correction and buffer management chips.

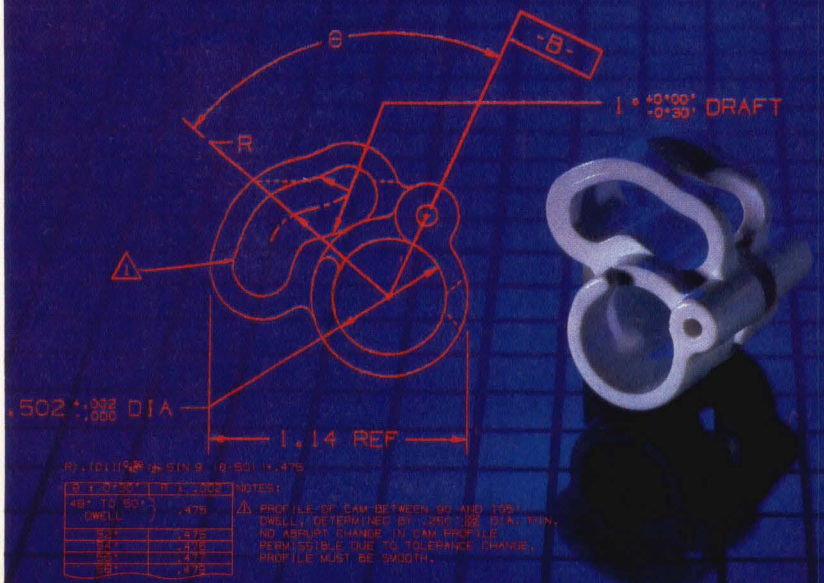
Wright Line, Worcester, Mass **(Booth N4816)**—ETS 2000 workstations are ergonomically designed; available in both fixed height and adjustable units, they include wiring ports and cable channels.

Wyse Technology Inc, San Jose, Calif **(Booth D2432)**—WY-100, WY-200, and WY-300 intelligent terminals provide ergonomic configurations with detailed keyboards and tilting color or monochrome displays.

Zilog, Inc, San Jose, Calif **(Booth S5611)**—UNIX based system 8000 microcomputers include the entry level 8-user model 11 with 18M-byte Winchester disk subsystem and 256K-byte main memory; high performance model 31 supports 8 to 24 users, 1M-byte memory, and SMD disk subsystem.

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CIRCLE 101

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Dave Hanna — V.P. Marketing and Sales, Grid Systems, Inc., Palo Alto, California



One of the hottest personal computers on the market is the new Grid Compass. It weighs about 10 pounds and takes up less than half of a standard briefcase.

Business Week calls Compass "a Porsche for top executives."

A custom Racal-Vadic modem is behind the smashing success of Compass. This VS212A/103 modem — complete with auto dial and auto answer — is built on a 6" by 6" PC board. "Without this built-in modem we couldn't have made the product," says Glenn Edens, V.P. of Development for Grid Systems, Inc., Palo Alto, California.

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CIRCLE 102

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CIRCLE 103

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PPC Engineers: (left to right)
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John Faivre
Ernest Sandoval
Luke Chang
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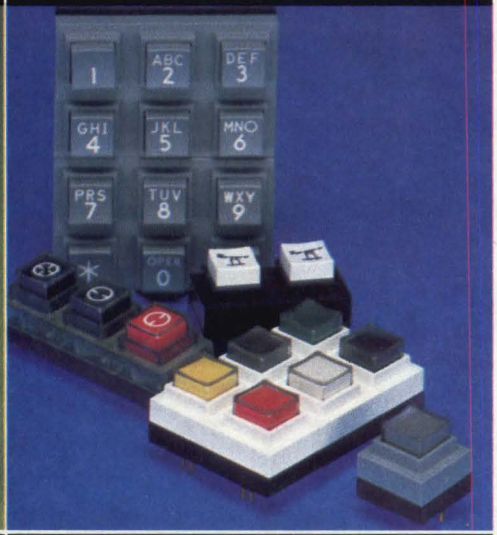
CIRCLE 104

GRAYHILL KEYBOARDS: DIFFERENT STROKES FOR DIFFERENT FOLKS

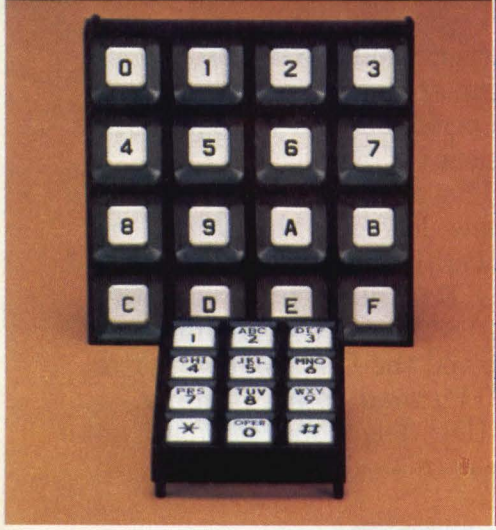
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CIRCLE 105

TWEAKING MORE PERFORMANCE FROM AN OPERATING SYSTEM

Hashing, caching, and memory blocking are just a few of the techniques used to punch up performance in the latest version of CP/M.

by David K. Brown,
Kathryn Strutynski, and
John H. Wharton

An operating system is inevitably constrained by its hardware. Moreover, a full featured operating system is useless if it consumes the very resources it is designed to make available to the user. As a result, early microcomputer operating systems were small and simple. While this maximized the memory available to application programs, it was at the expense of convenience and power.

Gone are the days, however, when random access memory (RAM) was a precious commodity. And thankfully so. The charge to today's operating system (OS) designer is to improve system performance. By managing magnetic mass storage and other input/output (I/O) resources more intelligently, current operating systems can boost existing hardware performance.

Even first time users quickly notice that a microcomputer's disk drives are seldom at rest. A microsystem grappling with large data bases spends up to 90 percent of its time waiting for disk transfers to complete. Thus, simply hiking the central processing unit (CPU) clock frequency, trimming memory access time, and otherwise fine-tuning the hardware has little effect on overall system throughput. Even replacing an 8-bit processor with a 16-bit version produces limited improvement if both require the same amount of disk activity.

A better approach to improving system performance is reducing the time spent waiting for disk transfers. A high performance operating system suitable for use with today's micro hardware should incorporate techniques like disk sector caching and directory buffering to eliminate as much disk activity as possible. The end result of using such techniques is that programs can run from three to six times faster. CP/M Plus is typical of this approach to OS design.

Part of the performance improvement of CP/M Plus is due to keeping copies of the most recently referenced disk data in memory. The operating system allocates a portion of RAM to disk sector buffers that store data read from, or written to, the disk. If an application program requests data that are in the buffers, the operating system need not read a disk. Further, if the hardware has memory to memory direct memory access logic, the data transfer can occur at full bus bandwidth.

CP/M Plus allocates sector buffers from a buffer pool following a modified least-recently used (LRU) algorithm. Usually, the buffer holding the least

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Kathryn Strutynski manages 8-bit operating systems software development at Digital Research. Ms Strutynski was project manager for CP/M 2.2, CP/M-86, and CP/M Plus. She has an MS in computer science from the Naval Postgraduate School in Monterey.

John H. Wharton is in charge of new technology development at Applications Research, PO Box 2038, Sunnyvale, CA 94087. As an applications engineer at Intel Corp, Mr Wharton helped propose and define component and system level products, including the MCS-51™ microcontroller family architecture. He holds a BSEE and an MSCS from Northwestern University.

relevant data is the first recycled when a new buffer is needed. However, the operating system overrides the LRU scheme if a series of sequential sectors are referenced. This avoids wiping clean the entire buffer area. The operating system maintains a separate set of buffers for directory sectors. This ensures that recently accessed directory information is retained, no matter how much data sector activity occurs.

Optimum physical sector size of high capacity floppy and Winchester disks often exceeds the 128-byte logical record length capable of being transferred by CP/M. When this is the case, CP/M Plus performs the combining (blocking) and separation (deblocking) of multiple logical records for each physical sector. As an application program requests the first of a series of sequential records, the operating system prereads several ensuing records. Multiple sector buffering is especially advantageous under these circumstances, since the ensuing records can be retained even if other disk activity occurs before the program actually needs them.

No charge for directory assistance

Some microcomputer operating systems waste considerable time searching disk directories when files are opened or randomly accessed. To find directory data for a given file, these operating systems start at the beginning and sequentially read sectors until they find the right entry. Ironically, it often takes longer to search a high speed Winchester disk's directory than that of a slower floppy disk because far more directory entries have to be examined. Clearly, system performance accelerates when directory searches are hastened.

In point of fact, the entire disk directory can be copied into RAM. And to locate a file, the operating system can quickly search a RAM based copy of the disk directory. When a file's state changes, both the RAM and disk resident directories can be updated. CP/M directories require 32 bytes/entry. In a Winchester disk with directory space for 256 files, one directory table consumes 8K bytes of RAM. But, memory is not yet completely free. Therefore, instead of a full directory cache, CP/M Plus implements a compact hashing scheme that can be searched quickly and requires far less RAM.

The first time the operating system accesses a new drive, it logs that disk onto the system. This is accomplished by reading each directory entry from the disk, condensing it into a 4-byte table entry, and then placing this entry in system RAM. For example, the eight filename characters and three filetype characters are hashed together to obtain an 18-bit value. A user number and status code add five more bits to the entry. This value is then stored in a hash index table. With this scheme, the complete RAM resident directory hash table for the previously mentioned Winchester drive can be reduced from 8K bytes to 1K bytes.

When the operating system looks for a particular file on the drive, it applies the same hashing algorithm to the file specification. Then the directory table is scanned for an entry with the same hashed value. If the disk contains the desired file, one of the hashed table entries will match the target value and identify the sector where the file's directory data can be found. The operating system then retrieves the full directory entry on its first disk access. Ideally, all other table entries show different hashed values, and can be ignored. Performance improvement gained by hashing is most pronounced when the target file cannot be found. In this case a conventional operating system is forced to read every directory sector. CP/M Plus, however, determines that the specified file does not exist without resorting to reading the disk at all.

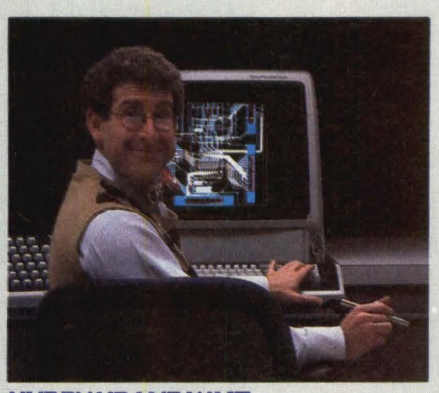
CP/M Plus lets the operator specify a "disk search chain" of up to four separate drives, one of which may be the default drive selected at execution time. The console command processor (CCP) searches each drive in sequence, looking for a filename that matches the command keyword and a type of .COM. Within each drive, the CCP first looks for a file saved under the current user number, then it checks the user 0 partition for a command file with the SYS attribute set. As soon as the file is found, the search chain stops and the command is executed.

An extended search chain like that of CP/M Plus would not be practical without the speed advantage of hashed directory searches. Up to 16 complete directory searches might be required to determine that a file being sought does not exist, as would happen if an operator mistyped a command name. Previous operating systems would take a great deal of time to exhaust the chains.

Any hashing function has the potential to produce the same hash value from different sets of input data. When such a collision does occur, CP/M Plus recognizes that the full entry read from the disk does not agree with its target file specification. This entry is then ignored and the operating system resumes scanning the hashed table for a second match.

Due to the hash field length, the odds against two filenames producing identical hash codes are about 2^{18} to 1. Though more conflicts arise in practice, empirical tests on a moderately full Winchester drive revealed only three conflicting pairs of file specifications. A CP/M Plus automatically performs all sector deblocking, data caching, and directory buffering. Further, these system

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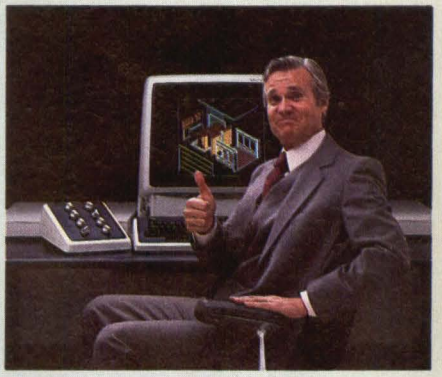
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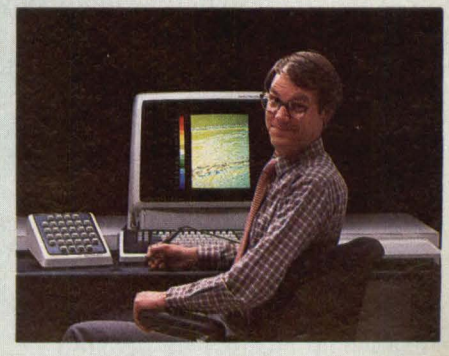
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CIRCLE 100

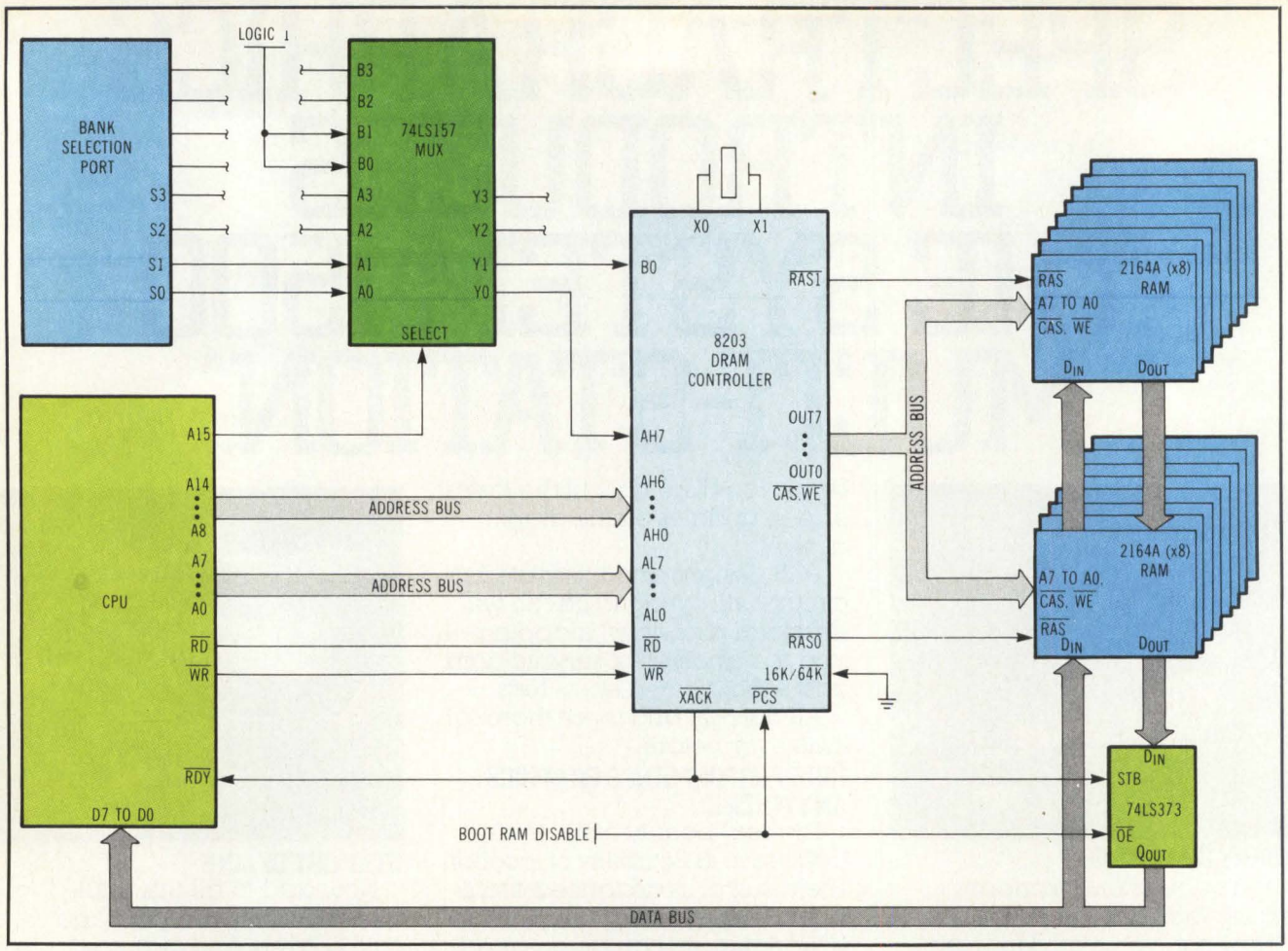


Fig 1 In a simple banked memory system, output port and multiplexer transform a 16-bit CPU address into 17 or more bits for extended memory array.

machinations are totally transparent to application software. Thus, CP/M programs do not need modifications to enjoy more efficient operation on CP/M Plus systems.

The operating system adds a special function to improve sequential I/O and accelerate program loading. By first calling the Set Multi-Record Count function, an application program can direct the operating system to transfer several logically sequential records during each ensuing read or write operation. The operating system, in turn, tells the I/O system how many physically sequential sectors are involved, and then calls the read or write sector routine once per sector.

System designers can handle sequential sector transfers two ways. The simplest approach is to ignore the record count value and transfer one sector at a time. If the host system disk controller is capable of high speed multiple sector I/O, however, the second approach would be to transfer the entire series in one burst.

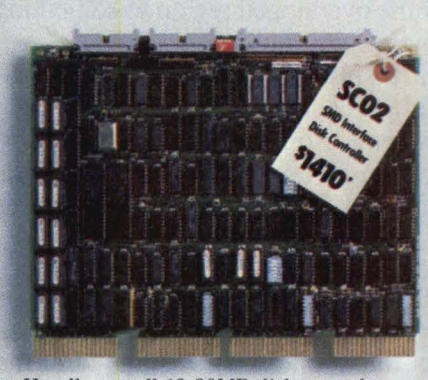
Expanding memory by banking

Very often, the price of performance is memory. Extra RAM is needed for sector buffers, directory tables, and the larger code of sophisticated OS algorithms. While addressability range is not an issue in 16-bit designs, it is with conventional 8-bit machines. In addition, increased OS size robs RAM from the transient application program area (TPA). How then are the users' desires for a more powerful operating system and ever larger RAM storage areas to be reconciled?

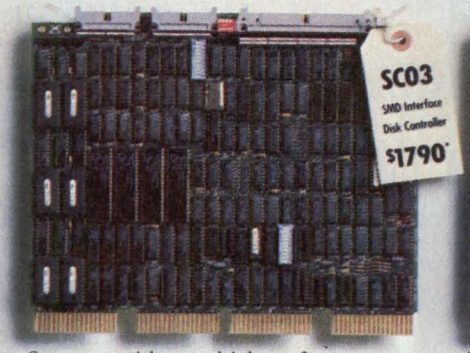
Fortunately, memory arrays larger than 64K bytes are becoming less expensive and more manageable. In addition, many hardware manufacturers now use bank switching techniques to overcome the addressing limitations of 8-bit processors. In such architectures, several blocks of RAM overlap the same portion of the processor's memory address range. Switching logic determines which block responds when the CPU addresses the overlapped area.

Fig 1 shows a typical banked memory system. An Intel 8203 dynamic RAM controller directly performs all address multiplexing and refreshing for an array of sixteen 64K-bit dynamic RAMs (DRAMs), (128K bytes). CPU address bits A14 to A0 connect directly to the 15 low order 8203 address input pins. Address bit A15 drives the 74LS157 multiplexer's select input. When A15 is low, the memory controller's two high order address bits are taken

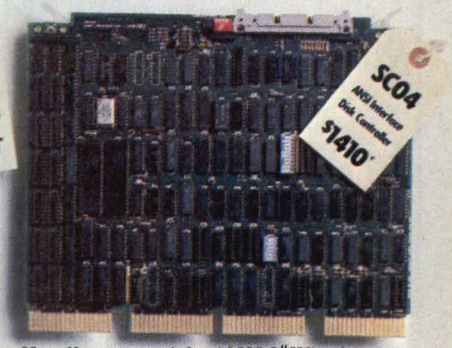
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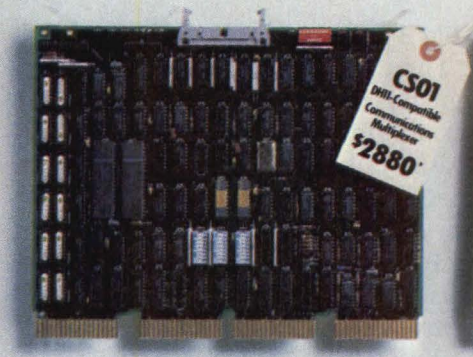
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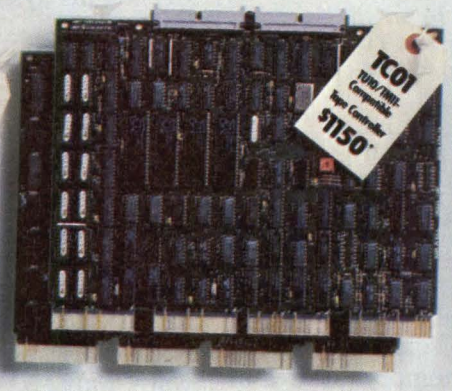
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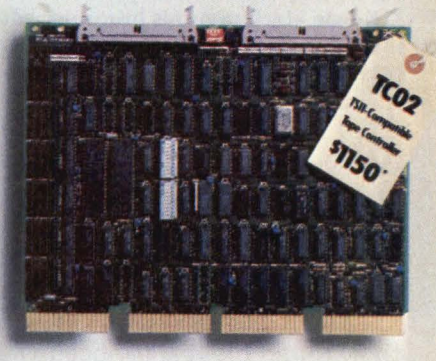


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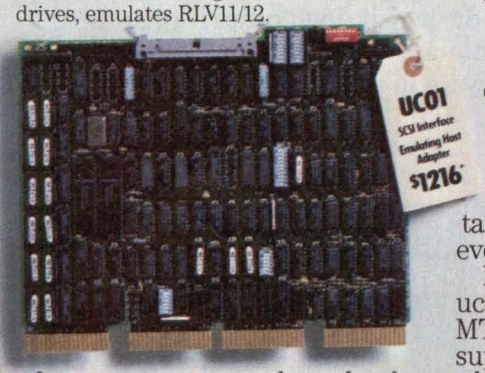
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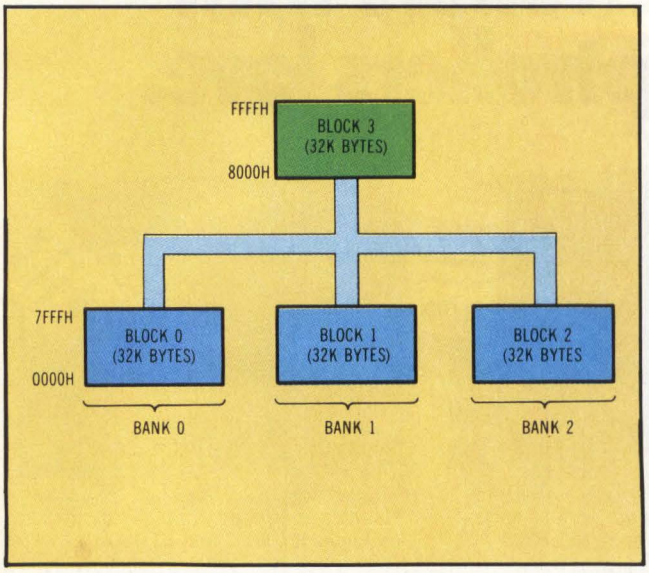


Fig 2 The CPU switches memory banks by selecting a 32K-byte block that fills low order addresses. The always-enabled common block contains routines to pass control and data between banks.

from the latched contents of an output port. Acceptable port pin values are 00, 01, and 10. When A15 is high, the multiplexer forces both high order controller address bits high.

Thus, the total array consists logically of four 32K-byte segments that combine to form three banks of memory. The CPU can select any of the first three blocks to occupy memory addresses 0000H through 7FFFH (32,767), by writing appropriate bits to the output port. The highest order block occupies addresses 8000H (32,768) through FFFFH (65,535) regardless of which low order block is enabled. Part of this block serves as a common area through which software in the low order blocks can communicate.

Fig 2 shows a map of the three banks as seen by the CPU. Notice that translation logic can also easily produce a 19-bit extended address, supporting 0.5M bytes of RAM. Theoretically, a different design might change the size of the overlapped region to something other than 32K bytes (typically 48K).

The OS software splits into two modules: resident and banked. The smaller resident module occupies the extreme top of each bank, and receives control when an application program calls an OS routine. The bulk of the OS software executes in its own alternate bank.

Fig 3 shows one way of dividing the memory system into application program, OS code, and OS data areas. The resident OS module supervises data transfers between the application program and the banked module, and it can be as small as 2K bytes. Put another way, the size of the TPA in a banked CP/M Plus system actually increases to more than 60K bytes.

In addition, Fig 3 suggests a way to improve OS responsiveness. The CP/M Plus CCP program interprets user commands. It must be reloaded after each application program has completed. If sufficient memory exists, this entire file can be stored in RAM. The operating system can then reload the CCP from memory in a matter of milliseconds, and prompt the operator for the next command. Thus, no disk activity is required.

In 8-bit systems without bank switching hardware, only two physical sector buffers are allowed: one for data, the other for directories. A simple, unbanked CP/M Plus system reduces TPA space slightly, leaving about 52K bytes for application programs.

CP/M programs usually adjust themselves to available memory space, and few require a full 52K bytes of TPA. The only detrimental effect the larger

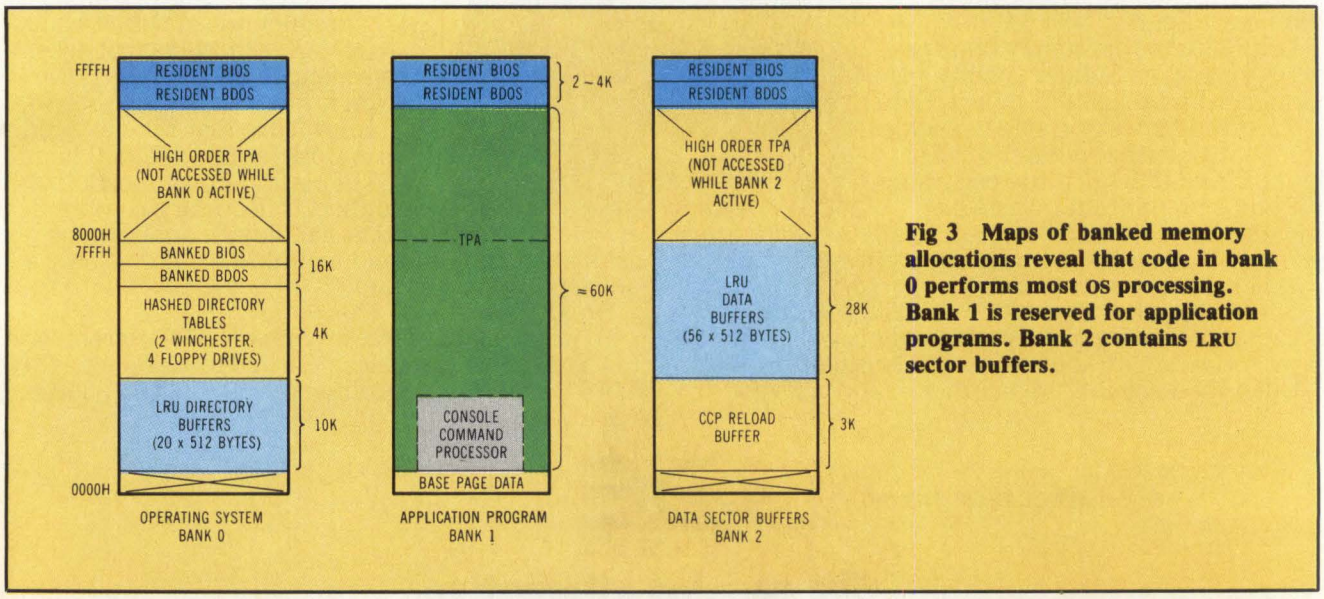
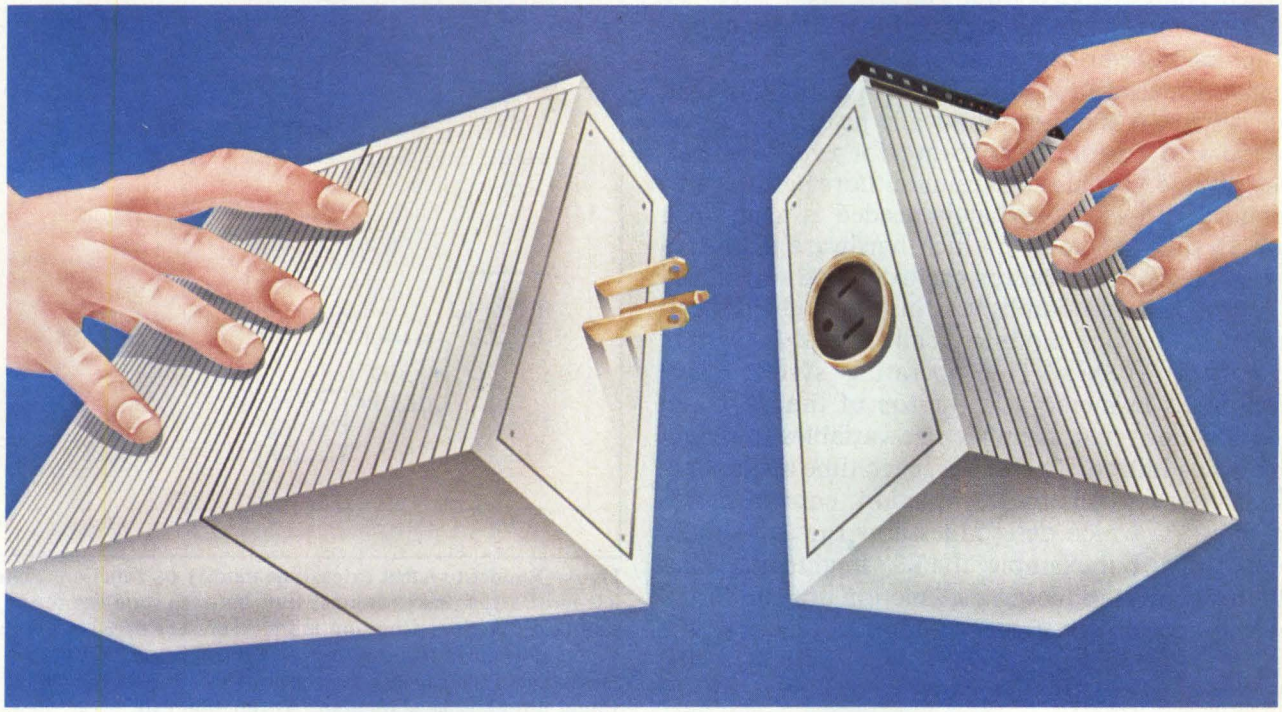


Fig 3 Maps of banked memory allocations reveal that code in bank 0 performs most OS processing. Bank 1 is reserved for application programs. Bank 2 contains LRU sector buffers.

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operating system has on application programs is reducing text and data buffer size. A system implementer may deem this acceptable, however, in light of reduced disk access time.

Room for expansion

As microcomputers extend into more esoteric fields, standard operating systems must often be customized for special applications. For example, graphics systems and their specialized peripherals demand special functions as well as a standard disk file system. It is not economically justifiable for OS vendors to customize software for every market. Nor should graphics program authors be forced to reinvent the wheel. What is needed is a uniform and flexible scheme by which hardware manufacturers or software vendors can extend OS functions.

CP/M Plus accomplishes this through generalized OS interface modules, called resident system extensions (RSXs). The operating system positions RSXs in memory at the top of the TPA, and adjusts the system memory size variables to reflect the new addition. Thereafter, each time an application program calls an OS function, control passes to the RSX, which determines how the call should be serviced. For example, the RSX might detect that the program is requesting a function not supported by the standard operating system. In this case, the RSX performs the processing internally. Or, the RSX might translate a new function code into a series of standard OS functions. It might also implement what normally would be a standard function in a different way. Function calls that do not relate to the RSX are conventionally processed.

An application program indicates in its file header that it incorporates one or more RSXs. The CP/M Plus program loader reads the entire disk file into memory and then relocates the RSXs before passing control to the application program.

The operating system removes an RSX that performs a one-time service when its associated program terminates. Memory allocated to the RSX is returned to the TPA at this time. As the name suggests, an RSX can remain resident after the program with which it was loaded completes. Thus, as shown in Fig 4, multiple RSXs can be present in memory at one time. When this is the case, each module filters out the functions with which it is concerned, and passes the remainder to the next higher module. The next higher module can be either another RSX or the operating system itself.

An RSX file can be attached to a null command file as a separate step before invoking programs that require its extensions. This technique conserves disk space by eliminating the need to attach a large RSX (eg, graphics package) to every program referencing it.

In addition to supporting applications oriented RSXs, CP/M Plus uses several RSXs in its own job.

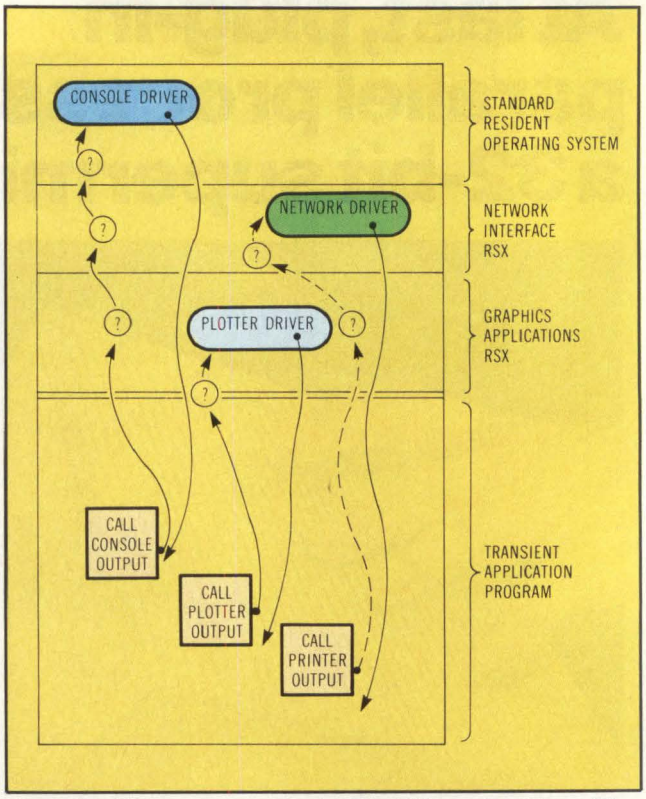


Fig 4 Resident system extensions modify OS functions. The left-most arrow traces control flow between modules for a standard function. Question marks represent decision points where either processing occurs or control is passed on. Dashed arrow illustrates the network RSX intercepting what would normally be a standard OS function call.

For instance, programs can load other program files for chaining and overlays. The loader function is implemented as an RSX, and does not reduce the TPA of programs not requiring that function. The SUBMIT facility for batch program execution is now implemented by an RSX that issues a specified command sequence. The RSX technique makes it possible to nest SUBMIT commands to an arbitrary depth.

CP/M Plus also handles I/O redirection via RSXs. The GET utility causes ensuing application programs to get their character input from a specified disk file instead of an I/O device like the console. Conversely, PUT causes output characters generated by a program to be sent to a disk file. Each utility works by installing an RSX that opens the specified file and later intercepts all corresponding OS function calls.

Any operating system maintains a large number of software flags and internal state variables, such as I/O system status or the current console cursor position. CP/M Plus has taken the novel step of documenting the functions and positions of many of its internal variables within a large data structure called the system control block (SCB). SCB information gives the I/O system software access to inside information for more flexible device driver routines.

Application programs can also monitor and, in a few instances, alter SCB data to suit special purposes.

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For example, a program might check the console characteristic variables in order to neatly format tabular data into the available screen width and length. The program could also toggle the flag that tells the operating system to echo console output to the printer, eliminating the need for an operator request.

CP/M Plus can stamp files with time and date each time they are modified. A second stamp optionally shows when the file was first created or last accessed. Files can be assigned passwords to discourage unauthorized use, and can be marked as read only or read/write. Each file carries several attribute flags. The standard peripheral interchange program provides an option that uses one of the flags to incrementally store files modified since the last backup.

To provide compatibility with earlier CP/M directory files, CP/M Plus intermixes two types of directory entries. As with earlier OS versions, the directory keeps each file's name, type, and sector allocation information in a 32-byte data structure, called a file control block (FCB). To maintain time and date stamping, CP/M Plus appends a special data structure, called a secondary file control block (SFCB), after every third regular FCB in the disk directory (see Fig 5). Each SFCB contains time and date stamps and a password protection mode code for the preceding FCBs.

As all four control blocks fit within a single 128-byte record, reading or updating the SFCB incurs no overhead. If a file's SFCB indicates that password protection has also been selected, a third type of control block appears elsewhere in the directory.

Because CP/M Plus understands directories with or without SFCBs, earlier CP/M disks are directly compatible with the new version. Conversely, prior OS versions simply ignore SFCBs in a directory. A utility program called INITDIR can rearrange existing CP/M disk directory entries to accommodate SFCBs. The new control blocks can be omitted if time/date stamping is not desired.

An improvement that many users can immediately appreciate is the ability of CP/M Plus to sense changes of removable disk media. Previous CP/M versions required the operator to explicitly reset the disk system after changing disks. Otherwise, the operating system relegated the new disk to read only status. Of course, there are still times when changing media can be catastrophic, but CP/M Plus puts the onus of this sin squarely on the operator.

Like earlier operating systems, CP/M Plus performs all I/O and other system dependent operations by calling a collection of subroutines, called the Basic I/O System (BIOS). The BIOS is the only module that must be changed to adapt the operating system software to different microcomputers.

A summary of BIOS functions appears in the Table, "Additional BIOS Functions of CP/M Plus." Sample routine source code comes with the standard distribution diskette. As with earlier CP/M, the BIOS must be modified to match the host system's exact characteristics, including memory and I/O port addresses, peripheral types, and disk drive organization.

BIOS routines are divided into several small source files according to the type of function performed. The macro assembler (RMAC) transforms these files into relocatable object modules, which are then combined by the LINK-80 utility program with an invariant BIOS kernel supplied on the standard system diskette. LINK-80 can also combine RMAC code modules with those produced by various Digital Research language compilers.

Factoring in people

Two noble objectives of any operating system are increasing system responsiveness and minimizing operator frustration. With this in mind, CP/M Plus introduces several features that tame the intolerant nature of its predecessors. The CCP program has been modified to help the operator find and execute command programs. A separate command file for each built-in CCP command handles the overflow of desirable features that would not fit in the CCP. If the operator specifies certain command options, the CCP loads the longer command file to finish the job.

The CP/M Plus banked version allows an operator to recall and edit previous command lines. An error can be fixed in three steps: First,

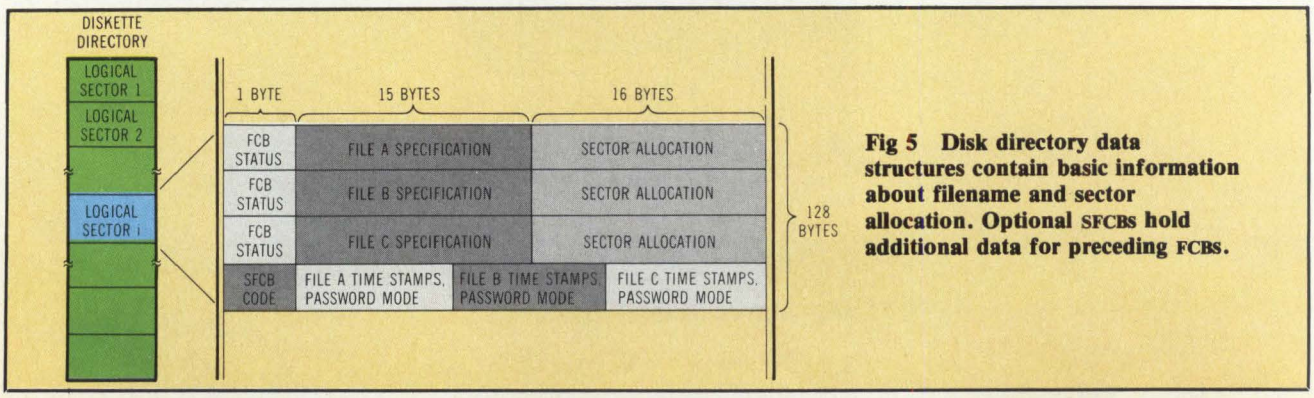


Fig 5 Disk directory data structures contain basic information about filename and sector allocation. Optional SFCBs hold additional data for preceding FCBs.

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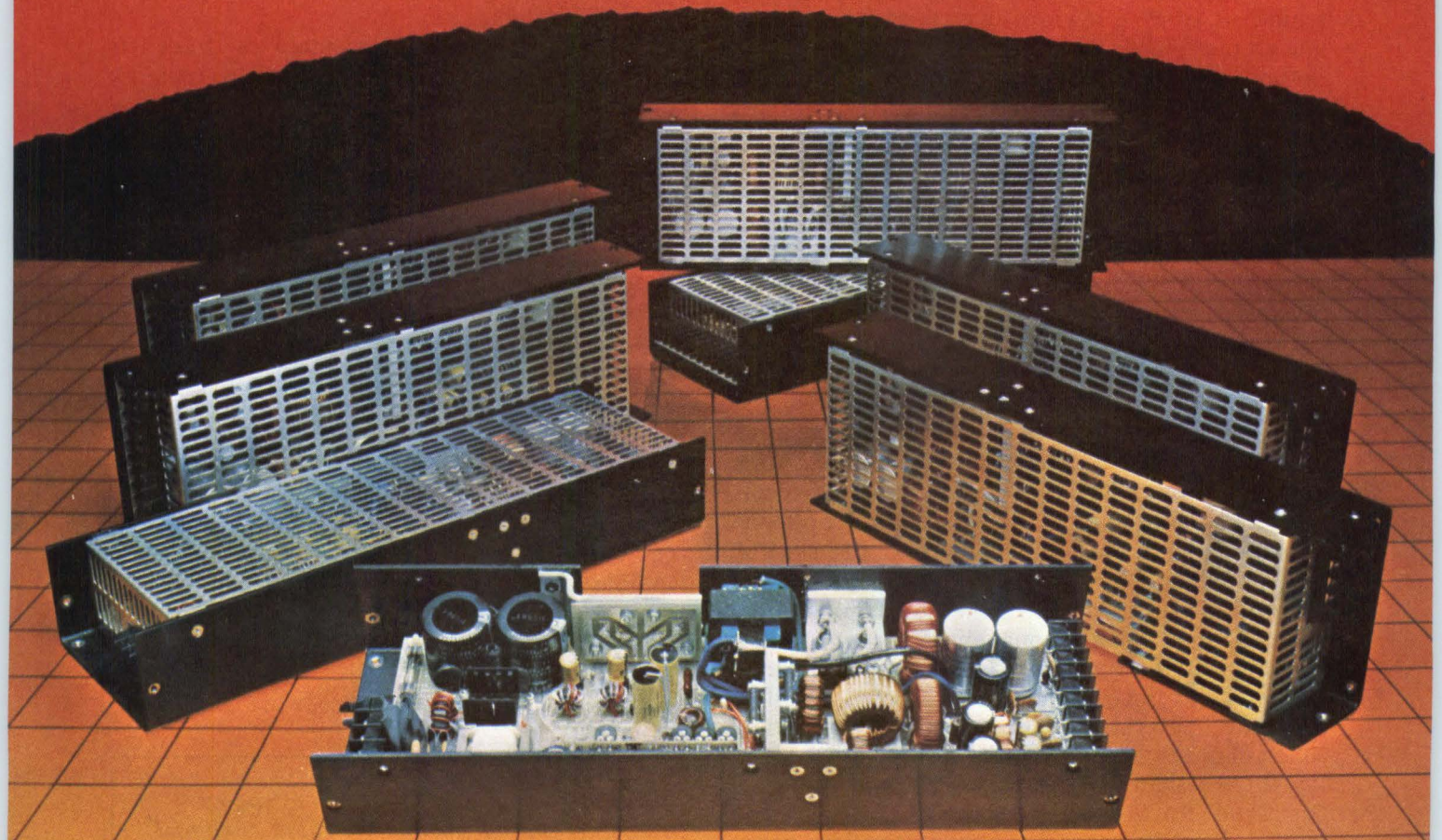
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Additional BIOS Functions of CP/M Plus

Routine	Description
*CONOST	Check if console ready for output character
*AUXIST	Check if auxiliary input character is ready
*AUXOST	Check if auxiliary output ready for character
DEVTBL	Access I/O device characteristics table
DEVINI	Initialize I/O device characteristics
DRVTBL	Access disk drive characteristics table
*MULTIO	Specify how many sectors to be transferred
*FLUSH	Flush user implemented deblocking buffers
MOVE	Move memory block between addresses
*TIME	Initialize or read system date and time
SELMEM	Select alternate memory bank for execution
SETBNK	Specify bank to be used for DMA transfer
XMOVE	Specify alternate bank required for move
*USERF	Reserved for system implementer
*RESERV1	Reserved for future OS use
*RESERV2	Reserved for future OS use

*May be null routine in simple implementation.

typing <Ctrl-W> rewrites an erroneous command line on the console with the cursor at the right end. Second, typing <Ctrl-A> several times moves the cursor to the error. And third, corrections are typed in. Hitting carriage return saves and retransmits the edited command line.

The CCP can also process multiple commands in one line. A series of commands separated by exclamation points executes in sequence once the final carriage return is struck. To break up long command sequences, pressing <Ctrl-E> returns the cursor to the start of the next line without starting command execution.

OS utility programs have also been revised, presenting a more convenient and consistent user interface. Those that require a command suffix generally prompt the operator for missing specifications. Some accept abbreviated and optional keywords within the command suffix. The general rule is that commands require only enough characters and keywords to make the desired operation unambiguous. All additional characters must comply with a fully expanded form of the command.

CP/M Plus incorporates more than 20 utility programs. Several give the operator information concerning system status, or let the operator reconfigure the assignment of I/O devices. The following command, for instance, tells the operating system to send all ensuing console outputs to both an alternate cathode ray tube and a line printer with the specified protocol and data rate

```
DEVICE CONOUT:=CRT2,LPT[XON,9600]
```

Documentation

Users get frustrated if forced to wade through documentation before being able to operate a new system. CP/M Plus provides documentation to address the interests of different readers. The User's Guide, for instance, develops all the concepts needed to run existing application programs, plus detailed reference information for all standard OS utilities.

Engineers developing new application programs must have an in-depth understanding of the operating system. A programmer's guide explains required data structures and the exact operation of each resident OS function. The programmer's utilities guide describes how to use the software tools provided with the CP/M Plus package. The system guide provides additional information needed by system designers. This includes a detailed description of each BIOS routine and a discussion of OS customization and installation procedures. CP/M Plus also provides an online reference facility directed toward users. Typing HELP displays a topic menu for which condensed reference information is available.

Operating system design involves tradeoffs between performance, flexibility, and memory requirements. Since a microcomputer's speed and convenience are becoming increasingly valuable to businessmen and professionals, it is now justifiable to splurge on memory consumption if throughput can be boosted. With this in mind, Digital Research improved the control program for microcomputer operating systems by combining record blocking, LRU sector caching, and hashed directory buffering to eliminate redundant disk activity, while actually increasing memory available to application programs.

Bibliography

CP/M Plus™ User's Guide

CP/M Plus Programmer's Guide

Programmer's Utilities for the CP/M Family of Operating Systems

CP/M Plus System Guide

Acknowledgment

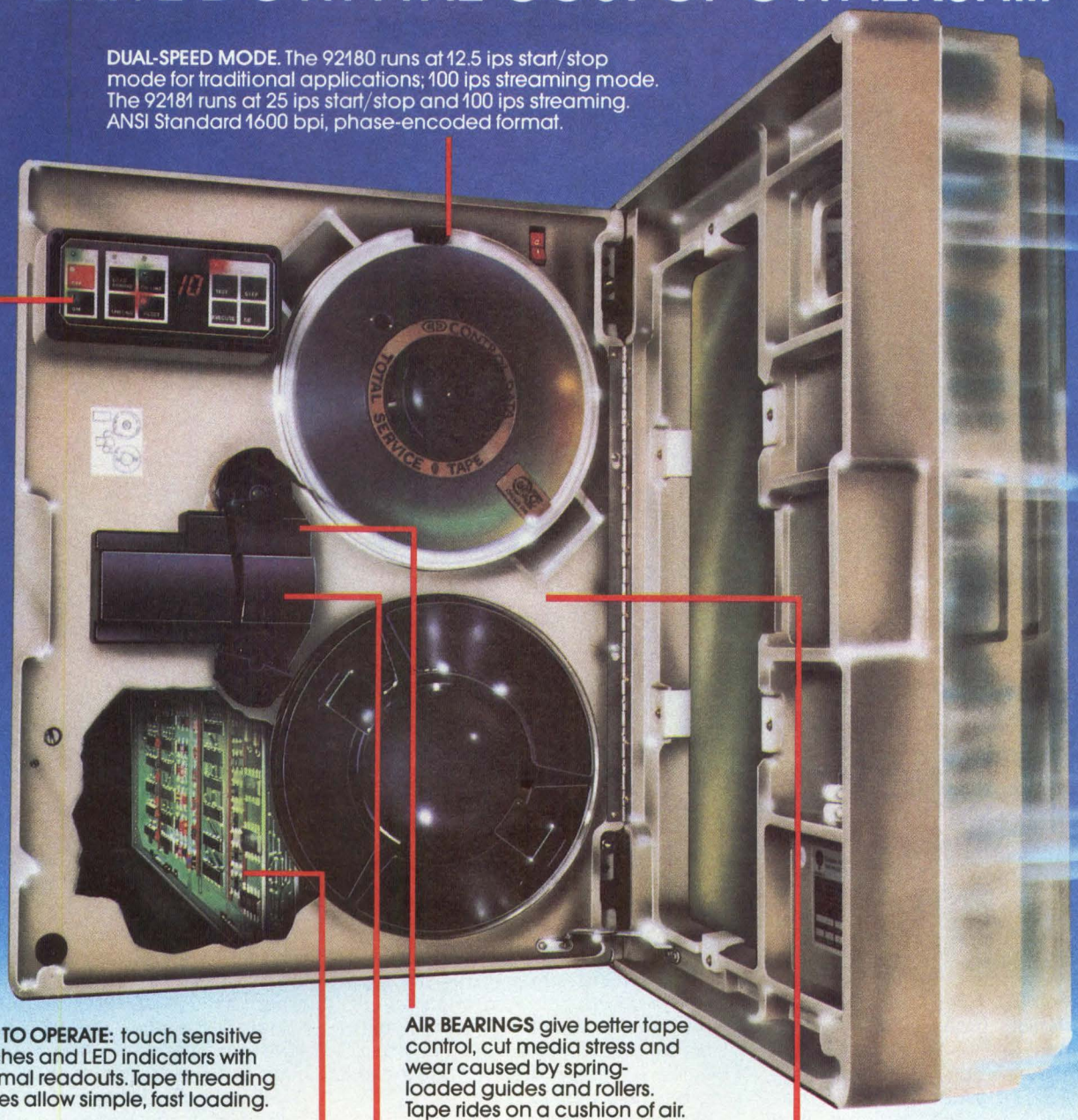
The authors would like to thank Susan Raab for her comments and criticisms during the development and review of this article.

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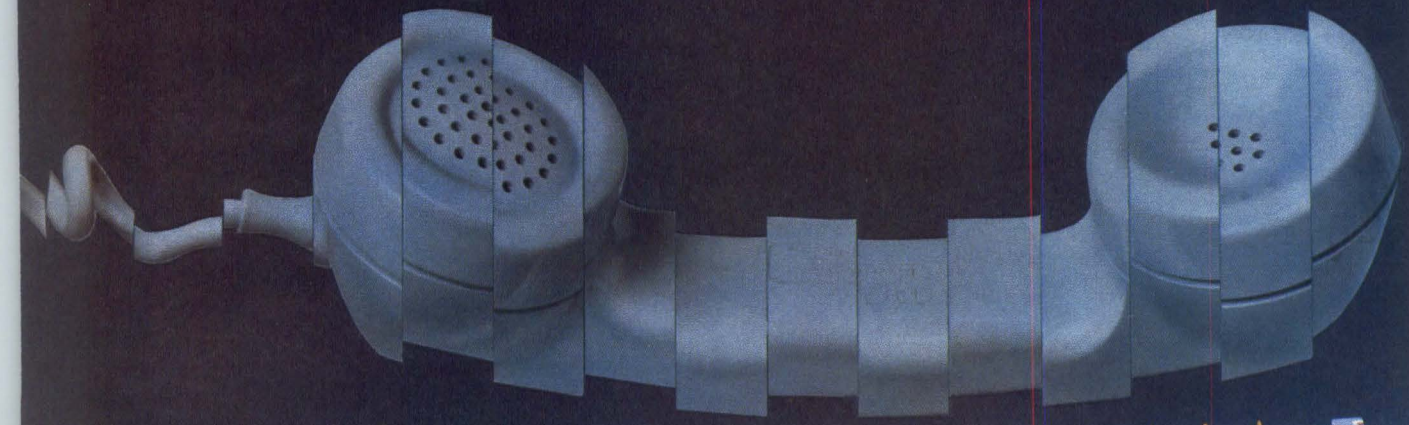


CONTROL DATA

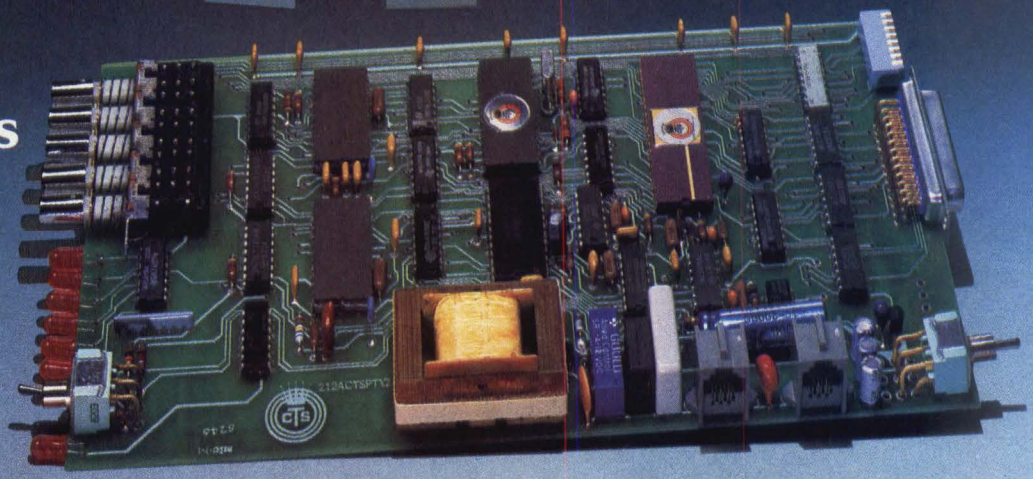
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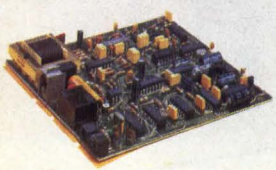


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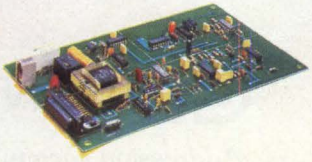
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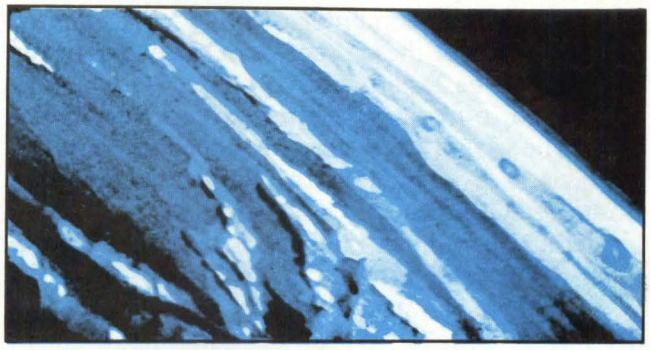
ZERO-G PROCESSING—COMPUTING ABOARD SPACELAB

Rugged space-bound computers, like those slated for launch later this year aboard Spacelab, incorporate unique solutions to architectural, radiational, and mechanical design dilemmas.

by William Connell Gibson

In October, NASA will begin operations of the Space Shuttle/Spacelab vehicle, in cooperation with the European Space Agency. The goal of this collaboration is to conduct scientific research from earth orbit. Spacelab is a modular, self-contained, computer controlled laboratory equipped with scientific instruments, equipment racks, and other materials required by its multidisciplinary research. It will be installed in the Space Shuttle Orbiter cargo bay where it will remain throughout each mission.

Spacelab provides a shirt-sleeve environment for the payload crewmen to conduct research in such varied fields as life and material sciences, astronomy, space plasma and solar physics, and earth observations. Instruments such as telescopes, which require direct exposure to the space environment, can be mounted on a U-shaped pallet located outside of the laboratory (see Photo 1). Instruments mounted on the pallet can be monitored and controlled by computer systems inside the laboratory.



A major policy departure from earlier NASA manned-flight programs involves removing some of the rigid design and development regulations that have traditionally been imposed on NASA equipment suppliers. Since the onboard operation of scientific instruments is not crucial to operational or flight crew safety, NASA has reduced the quality control and assurance requirements on instrument developers, and thus, realized a significant savings in cost. Since Spacelab will be flown many times over the next decade and carry with it new instruments each time, neither NASA nor the European Space Agency (ESA) can afford the development cost of so many instruments built to older Apollo standards.

William Connell Gibson is manager of the Spacecraft Engineering Section of the Dept of Space Sciences at Southwest Research Institute, 6220 Culebra Rd, San Antonio, TX 78284. He is responsible for the SEPAC interface unit for Spacelab 1 and the onboard data handling system for an OPEN project satellite. Mr Gibson has a BS in engineering sciences from Centenary College, Louisiana.

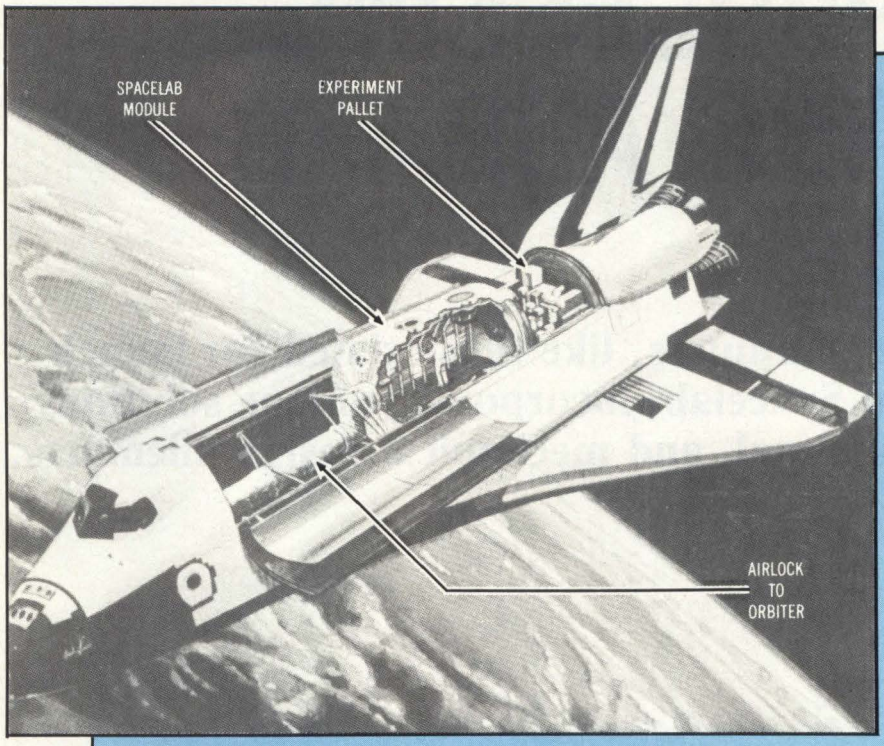


Photo 1 Spacelab, shown with long module and one experiment pallet installed in Orbiter cargo bay, can also be configured without a module. The SC-1 computer resides on the equipment pallet.

The heart of the Spacelab command and data management system (CDMS) is a cluster of three general purpose computers. Table 1 shows the characteristics of these processors. Only one of the processors, the experiment computer (EC), is normally used to manage scientific experiment operations. The second computer, the subsystem computer (SSC), is used to manage the Spacelab operation. Both the EC and the SSC operations are backed up by a third computer known as the backup computer (BC). The EC and its software operating system, the experiment computer operating system (ECOS), provide a wealth of data management resources to the scientific instruments located within the laboratory and/or on the pallet.[1]

Scientific instruments are connected to the Spacelab CDMS through the experimental remote acquisition units (RAUs), the high rate multiplexer, and the video switching network. Through these three subsystems, scientific instruments receive commands, transmit data, and acquire time synchronization from Spacelab or the Payload Operations Control Center. The RAUs are designed to acquire analog and discrete signals from the experiments and to transmit pulsed or level discrete commands to the equipment controlling the experiments. They also provide a 1024-kHz master time clock with an associated 4-Hz update clock for experimental use.

Four serial communication ports are also available at each RAU. These 1M-bps, duplex-serial data channels provide a means for processors—called dedicated experiment processors (DEPs)—that are built into scientific instrument systems to communicate with the EC. The ECOS provides software services to support realtime communications between the experiment's unique application

TABLE 1

General Characteristics of CIMSA-125 Processors

Configuration
Microprogrammed control unit, cycle time 300 ns (control store 4K x 16 or 20 bits)
Word size
Instructions: 16 bits Data: 8, 16, 32, and 24 (floating point) bits
Cycle time
Microcycle time = 300 ns Instruction cycle time = $<$ 1 μs through 10 μs (128 total instructions)
Memory capacity
64K x 16 ferrite core (16 data, 1 parity, and 1 protect bit) 420-ns access time, 920-ns cycle time
Interrupt capability
8 external 5 internal
Addressable registers
4 specialized 62 dedicated 7 base
Operational speed
3.2×10^5 operations/s (Gibson mix)

software running in the EC and the experiment's DEP. In this manner, data that are available to the EC from the Orbiter's general purpose computer can be relayed to experiments.

Telemetry from an experiment can be pulse code modulated and transmitted through one of the several direct access channels on the high rate multiplexer. Television or very high frequency analog signals (≤ 4.5 MHz) can also be transmitted to the ground receiving station through one of the laboratory's video channels.

Applications for ruggedized processors

As mentioned earlier, new scientific instruments and support systems will be developed for each Spacelab flight. Many of the experiments employ either a microprocessor or a ruggedized mini- or microcomputer. On Spacelab's first flight, three ruggedized minicomputers (LSI-11, Rolm, and IBM NASA Standard Spacecraft computer) and a host of microprocessors will control the more than 60 onboard experiments. For some later Spacelab missions, many times this number of ruggedized processors are being planned.

There are limitations in using most commercially available ruggedized minicomputers as dedicated experiment processors on Spacelab. First, since funding for Spacelab experiments is more in line with frugal sounding rocket programs than with manned flight programs, the first limitation is price. The second limitation is that for many experiments, the processor must operate in a hard vacuum environment where the only means of removing heat is by conductive dissipation through the baseplate. Finally, to provide adequate support for most experiments, the processor must have extensive I/O capabilities.

There are few inexpensive, ruggedized processors that satisfy environmental and operational requirements.

The environmental specifications for Spacelab equipment fall under three main headings: electromagnetic interference (emi), vibration, and thermal vacuum. In addition, all metallic and nonmetallic materials used must be reviewed and approved by NASA. Although no radiation specifications are currently imposed on Spacelab equipment developers, concerns about anomalous behavior of some experimental systems on the STS-3 mission may result in the inclusion of a radiation specification in later missions. Table 2 provides a brief summary of environmental specifications for a typical scientific experiment on the Spacelab pallet.

Once an experiment has successfully completed environmental qualification testing and the thousands of hours of software development testing usually associated with a Spacelab experiment, it is then ready to be installed on the Spacelab pallet. This takes place at the Level IV integration facility at the Kennedy Space Center in Florida. From this point on, it becomes increasingly difficult to gain hardware access.

TABLE 2

Environmental Design Specifications

Vibration

Sinusoidal — Amplitude

Frequency	x axis	y axis	z axis
5 to 15 Hz	1.0	1.0	1.0
15 to 35 Hz	3.0	1.0	4.7
35 to 50 Hz	1.0	1.0	1.0

Random

Frequency	Power Spectral Density
20 to 50 Hz	.0045 g^2/Hz
50 to 200 Hz	9.0 dB/octave
200 to 415 Hz	0.3 g^2/Hz
415 to 2000 Hz	−9.0 dB/octave

Operating Pressure

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Electromagnetic Compatibility

MIL-STD-461:
CE01, CE03, CS01, CS02, CS06, RE02, RE04, RS03

Experience with DEPs on Spacelab 1 has shown that the most difficult problem to cope with is that of changing programmable read only memory (PROM) resident software after a DEP is mounted on the spacecraft. It is almost inevitable, given the nature of scientific research and the number of Spacelab interfaces that have to be debugged, that DEP software will have to be changed at least once during Level IV integration. Needless to say, removing an instrument from a manned spacecraft after it has been formally accepted for flight is no small matter. Because of these hardware access problems, software patching is likely to become necessary for flight DEPs, even after spacecraft integration.

Second only to the problem of reprogramming PROMs is the problem of trying to troubleshoot a DEP. One strategy used to solve this problem is to program the DEP to continuously write status information into a dual-ported telemetry memory buffer. By inspecting the realtime telemetry displays in the control room, operators have been able to isolate most problems. The lesson learned here is to design enough diagnostics into the DEP support equipment to allow remote troubleshooting.

A survey conducted during the development phase of a Spacelab 1 experiment revealed that there are few reasonably priced, ruggedized

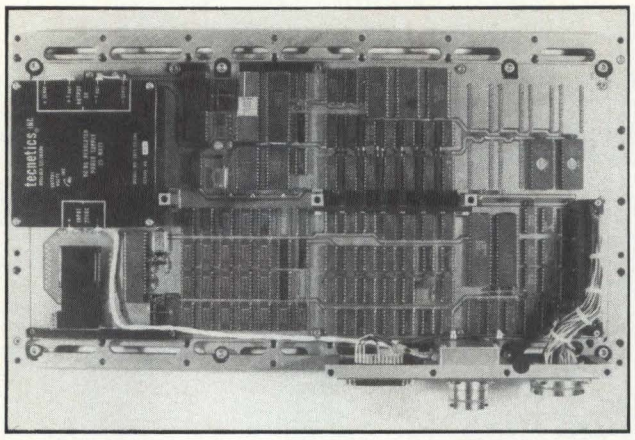


Photo 2 SC-1 Spacecraft Computer is emi/rfi tight and dissipates heat through its baseplate. The cabinet's low vertical profile helps minimize launch-induced loads in the X-Y plane.

processors available that satisfy environmental and operational requirements. Worse still, it was unnerving to discover that vendor claims regarding their equipment's ability to meet specific MIL STD specifications could not be substantiated by any test data.

In response to these concerns, the Department of Space Science at Southwest Research Institute developed the SC-1 Spacecraft Computer shown in Photo 2. The SC-1, built to withstand the environmental specifications shown in Table 2, uses the 5-MHz Intel 8086 in unison with 8087 and 8089 very large scale integration (VLSI) processors. All reside on the system's local bus. Fig 1 is a block diagram of the processor, and Table 3 summarizes the SC-1's general specifications.

The processor's memory is divided into three subsystems. For permanent program memory, the SC-1 provides 64K bytes of erasable PROM (EPROM) memory expandable to 128K. An optional small, 2K-byte static random access memory (RAM) buffer is recommended for use as the system stack. For applications requiring a large data memory or for situations where programs are executed out of RAM, the SC-1 has a fault tolerant 128K dynamic RAM (DRAM). An Intel 8206 error correction code device and a 6-bit wide check code memory are used to provide a single-bit detect/correct, multiple-bit detect capability for the 128K bytes of DRAM. The self-scrubbing memory controller

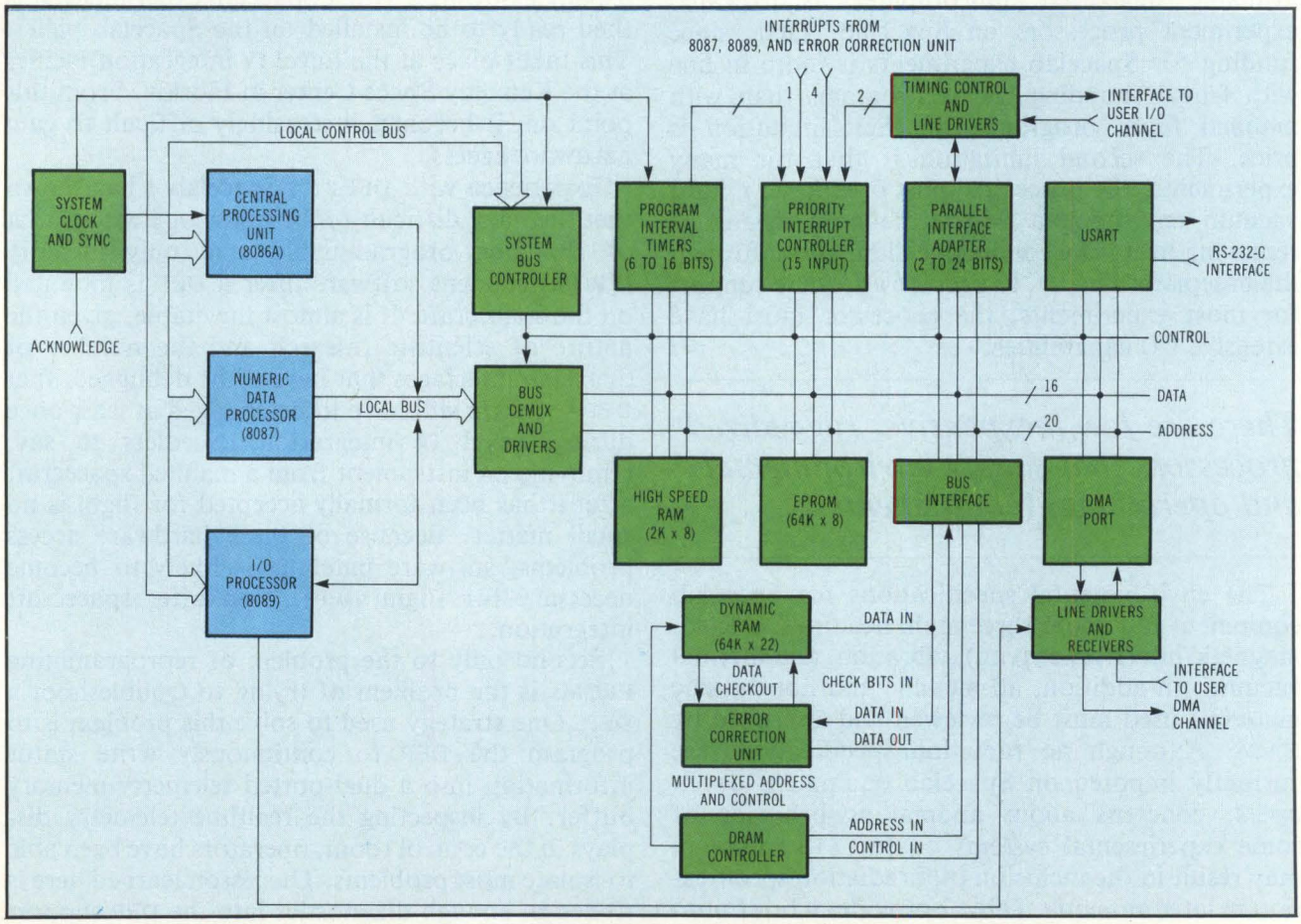


Fig 1 Block diagram of SC-1 computer shows arrangement of 8086, 8087, and 8089 VLSI processors on the local bus. The computer is equipped with 128K bytes of fault tolerant DRAM, up to 128K bytes of EPROM, timers, interrupt controllers, and ample I/O.

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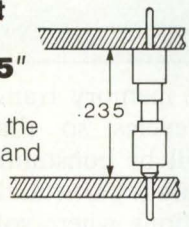


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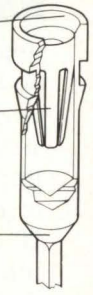
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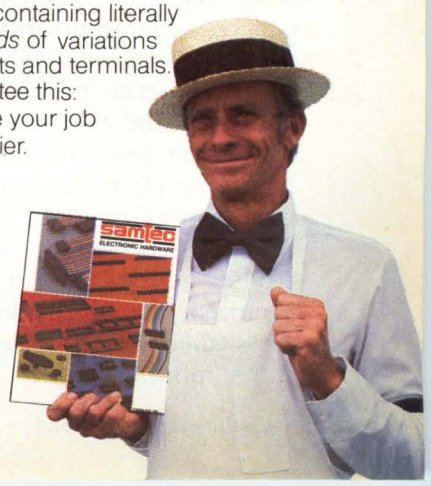
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TABLE 3

General Specifications for SC-1 Flight Computer

Configuration

8086/8087/8089 tri-processor on local bus

Word size

Instructions: 8, 16, 24, or 32 bits
Data: 8, 16 bits (single word = 16 bits)

Cycle time

Basic instruction cycle: 0.8 μs (instruction not in queue)
0.25 μs (instruction in queue)

Memory capacity

Onboard EPROM: 64K bytes (expandable to 128K)
Onboard DRAM: 128K bytes (error correcting, single-bit detect correct; multiple-bit detect)
Onboard SRAM: 2K bytes

I/O capacity

Parallel: 48 lines programmable (8255s), using two parallel interface adapters (equipped with LSI controller to emulate IBM-360 I/O channel handshaking)
DMA: Two 16-bit DMA ports, at 1M-byte/s max transfer rate
Serial: RS-232 port, controlled by USART for both standard asynchronous or synchronous (8251A) communications

Interrupts

Two 8-input priority interrupt controllers (15 hardware vectored interrupt lines available). Software configured for input priorities and mode (8259As).

Timer

Two timers, each equipped with three 16-bit interval timers. (Timer outputs available as interrupt inputs.) Software configured for mode and rate (8253s).

Power consumption

20 W

Weight

9.38 lbs

used with the DRAM manages all memory transactions as read/modify/write cycles so that corrected data and check bits will be constantly written back to memory. This feature is particularly important in spacebound applications where soft errors from galactic cosmic rays are a real concern. If a single-bit error is encountered, a program interrupt is generated and the physical address of the error's location in DRAM is latched in a special error register. Likewise, if a multiple-bit error occurs, a higher priority interrupt is generated and the error address is again stored.

For general purpose timekeeping and event counting, the SC-1 uses two 8253 interval timers. These devices can be software configured for binary or binary coded decimal counting and are mode programmable for several types of output functions. A pair of cascaded 8259 interrupt controllers is used to provide a total of 15 hardware vectored interrupt inputs. As with the 8253s, the 8259s can be software configured for several operational modes.

I/O functions and throughput performance

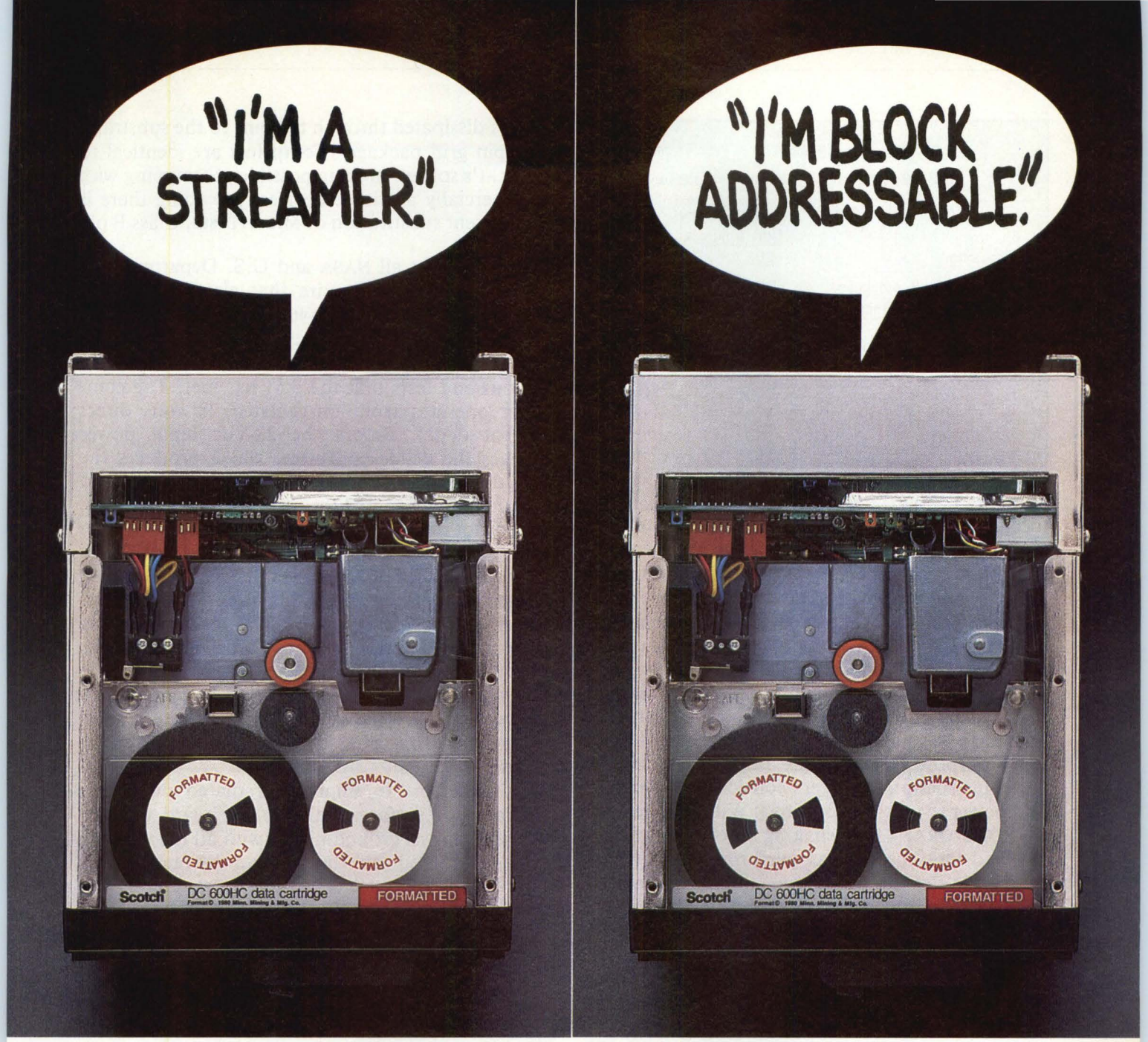
The SC-1 provides three types of onboard I/O functions. For parallel I/O functions, it uses a pair of 8255 programmable peripheral interface chips supported by a programmable array logic (PAL) register. The result is a 16-bit output bus and a 16-bit input bus. The PAL is programmed to perform as a finite-state machine and is used to translate the 8255's mode 1 handshaking into a subset of the IBM 360 I/O channel handshaking protocol. By reprogramming the PAL, other types of bus handshaking schemes can be produced. Open collector buffers are used as line drivers for the output bus, and transmission line terminators followed by Schmitt trigger receivers are used to receive signals on the input bus.

For normal terminal communications, the SC-1 has available an 8251A universal synchronous/asynchronous receiver/transmitter (USART) and RS-232-C line drivers and receiver. The third type of I/O that the SC-1 provides is direct memory access (DMA). The SC-1 has two hardware dedicated DMA ports, one for input and one for output under control of the 8089 I/O processor. Circuitry is provided to generate channel attention commands to the 8089 from either external hardware or onboard software. To the external DMA channel user, DMA handshaking appears similar to that used by the IBM NASA Standard Spacecraft computer. A software controlled lock-out feature is also provided that prohibits external channel attention commands from getting through to the 8089. As with the parallel I/O bus, the DMA ports use high current line drivers for output lines and terminated line receivers for inputs.

In its current configuration, the SC-1 uses the 5-MHz 8086 with an 8087 and 8089 to provide increased throughput. With the 8086's pipelined architecture, instructions already held in the instruction queue can be executed in 260 ns. This same instruction would require 800 ns to execute if the 8086 was required to fetch the instruction from memory. In addition, the circuit design allows the SC-1 to be upgraded to 8 MHz.

The 8087 adds considerably to the SC-1's performance in terms of floating point calculations. Table 4 shows the dramatic reduction in execution time by using the 8087 over 8086 software algorithms in performing floating point calculations. The 8086/8087 hardware interface allows the 8087 to request from the 8086 the use of the system bus to fetch or store an operand for a floating point calculation. Since the 8087 constantly monitors the 8086 instruction stream and asserts control when it recognizes certain instructions of its own, it does not interfere with the normal 8086 instruction execution.

The primary role of the 8089 I/O processor is that of intelligent DMA controller. In the



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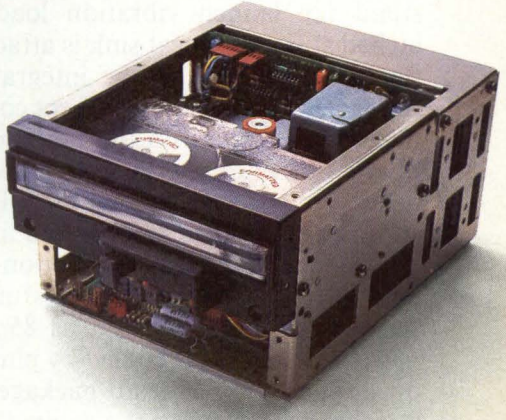
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TABLE 4

8086/8087 Emulation Speed Comparison

Instruction	Approximate Execution Time (microseconds) 8087	8086
Multiply (single precision)	19	1600
Multiply (double precision)	27	2100
Add	17	1600
Divide (single precision)	39	3200
Compare	9	1300
Load (single precision)	9	1700
Store (single precision)	18	1200
Square root	36	19,600
Tangent	90	13,000
Exponentiation	100	17,100

local bus mode, the maximum transfer rate under 8089 control is 1.24M bps. Since the arguments for the DMA transfer (source address, destination address, and termination criteria) are passed from the 8086 to the 8089, the system has intrinsic memory protection for DMA transfer. Further, the 8089's intelligence in forming the 20-bit effective source and destination address eliminates the requirement imposed by some hardened processors that these addresses be generated externally. Although its primary purpose is to provide DMA operations, the 8089's instruction set offers considerable flexibility and power to all I/O operations. With the use of the REQUEST/GRANT handshaking scheme between the 8086 and 8089, the 8089 can perform many I/O tasks on a cycle stealing basis, thus minimizing interference with the 8086 software execution.

Packaging design for space

As can be seen in Photo 2, all SC-1 circuitry is mounted on a single, 3/32″ (0.24 cm) thick circuit board. The circuit board is physically supported at 16 points to provide the necessary strength to withstand the launch vibration loads. A chemically etched aluminum heat sink is attached to the circuit board to allow all of the integrated circuits, with the exception of the 8206, direct contact with it. The heat sink, located on the periphery of the circuit board, attaches to the SC-1's case and conducts heat directly to the baseplate. With this packaging scheme the SC-1 can be operated in a vacuum where only conductive heat dissipation is possible. The computer will operate successfully with its baseplate temperature as high as 85 °C or as low as −40 °C. The 8206 is cooled by placing a metal plate on top of the 68-lead package, and thermally attaching the plate to the cabinet's structure.

The 8206 represents the first in a series of 68-lead VLSI devices that will be packaged in a 68-lead (cavity-down) pin grid. The chip is cooled primarily from the top of the package since very little heat is dissipated through the pins to the substrate. The pin grid package's footprints are identical to the SC-1's socket, making possible prototyping with commercially available devices, providing there is subsequent substitution of MIL-STD-883, Class B pin grid parts.

Since almost all NASA and U.S. Department of Defense programs require that electronic equipment meet the MIL-STD-461's emi requirements, considerable effort was given to the packaging and power system design. Table 2 includes a list of the various emi tests that the SC-1 has met. The computer operates from unregulated 28 volts direct current (Vdc). Before the 28-Vdc input power reaches the dc/dc converter, which produces the 5 V dc for the processor, both the supply and return lines are routed through shielded line filters. Filters not only help reduce the reflected power line noise, but also eliminate the high voltage spikes that are imposed on the power lines during the conducted susceptibility tests. The use of a dc/dc converter to provide regulated 5 V to the logic (as opposed to a series pass regulator) improves the processor's power efficiency and, more importantly, meets NASA's requirements for electrical isolation between primary and secondary power return lines, primary return to chassis, and secondary return to chassis.

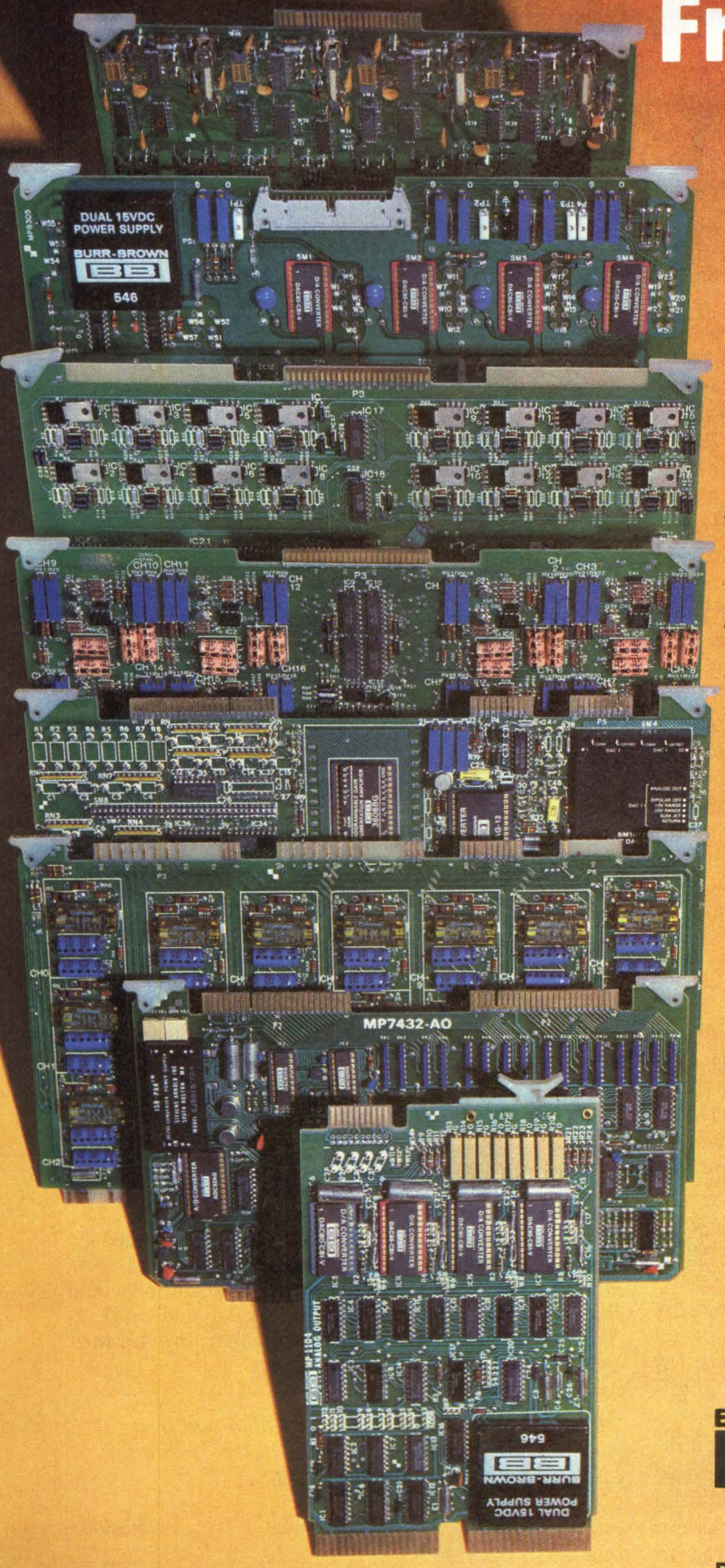
In an effort to minimize radiated noise, the entire upper surface of the circuit board was laid out as a chassis ground plane, with all the working voltages routed on the bottom surface of the board. This approach is possible because of the use of a very high connection density multiwire circuit board in which multiple levels of interconnection are possible.

The SC-1's packaging design makes it resistant to electromagnetically noisy environments or environments where shock and vibration levels are high. The SC-1's low profile cabinet was chosen to minimize the structure's moment arm to launch acceleration loads and other induced loads in the X-Y plane.

An expansion chassis has also been developed for the SC-1 for applications that require extensive I/O. This chassis provides 20 additional card slots and can be populated with an assortment of analog to digital and digital to analog converters, parallel digital, serial digital, or power driver interface cards. The expansion chassis' packaging allows the SC-1 to be directly attached to it. Like the SC-1, the expansion system is emi/radio frequency interference (rfi) tight and can operate to the same thermal, vacuum, and vibration specifications as the SC-1.

An effort is underway to radiation harden the SC-1 to x-ray, electron, and proton irradiation. In many satellite and interplanetary spacecraft

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applications the total vulnerability of an unshielded electronic device can be extremely high.[2,3] N-channel devices are not traditionally used in such applications because of their reputed radiation softness.

Fig 2 shows the radiation behavior of Intel's HMOS II, HMOS I, and NMOS families. It is surprising to see the VLSI's improvement in radiation resistance over its NMOS predecessors. Intel attributes this improvement to the thinner gate oxides of the HMOS II components (400 Å) as opposed to earlier NMOS (1000 Å), and to the lower process temperatures to which HMOS devices are exposed.[4]

Although it is not possible to adequately shield the SC-1 for every spacebound application, it is possible that a multilayered shield can provide sufficient protection for all but the most severe orbits. The primary sources of damaging radiation to spaceborne electronics are the 5 MeV and below electrons and the 500 MeV and below protons. At these energies, charged particles can easily penetrate the satellite's skin as well as the electronics enclosure's walls. Galactic and solar cosmic rays are also a concern, but for species exhibiting sufficient energies to cause problems, the fluxes are actually quite low.[5] Thus, cosmic rays seem more a source of occasional, random errors than of permanent damage.

The selection of materials for electron and proton shielding has to be made carefully since the bremsstrahlung x-ray by-product, created by the absorption of incident electrons, is proportional to Z^2 (Z = atomic number) of the shielding material. For this reason, a low Z material is preferable for the shield's outer layers. To attenuate any residual x-ray flux, a high Z material such as gold, tantalum, or other heavy material is preferred.

Software aspects

Since the 8086 is quite popular in the 16-bit microprocessor marketplace, software support for it is plentiful. The Intel Series III Development System, for example, provides high level language (FORTRAN, Pascal) development tools as well as a comprehensive hardware in-circuit emulation. For applications not employing a high level language, the new Intel PDS-100 can provide field portable development capability in a personal computer sized system for under $10,000.

Numerous other system and software vendors are marketing development tools for 8086 based designs. Languages such as C, Ada, and Forth, as well as UNIX-like operating systems, are also available from a wide range of sources.

The pending Spacelab program offers new applications for ruggedized, inexpensive, and serviceable mini- and microcomputers. Project scheduling for Spacelab requires that the scientific instrument systems, including the computer, be delivered to the spacecraft integration facility over a year before flight. This early delivery often means troubleshooting hardware and modifying software under difficult circumstances. Long-range design strategies, coupled with today's highly reliable and compact hardware, however, are making the journey toward the stars a reality for high flying microprocessors.

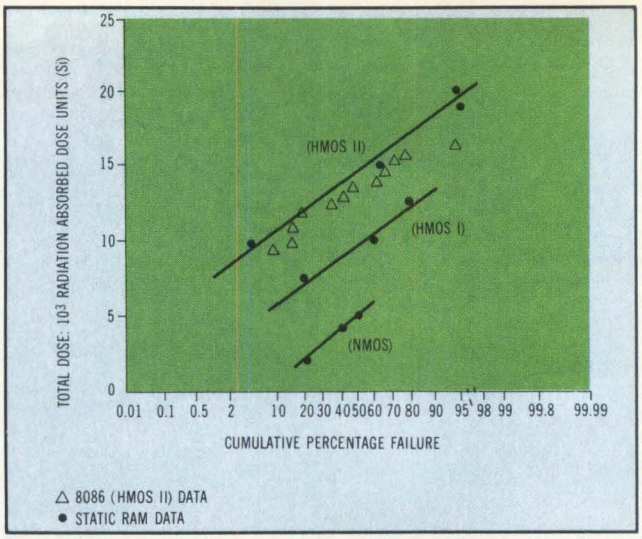


Fig 2 The graph shows radiation characteristics of various logic families, particularly the improvement in radiation resistance of newer devices. This improvement is attributed to thinner gate oxides and lower precise temperatures.

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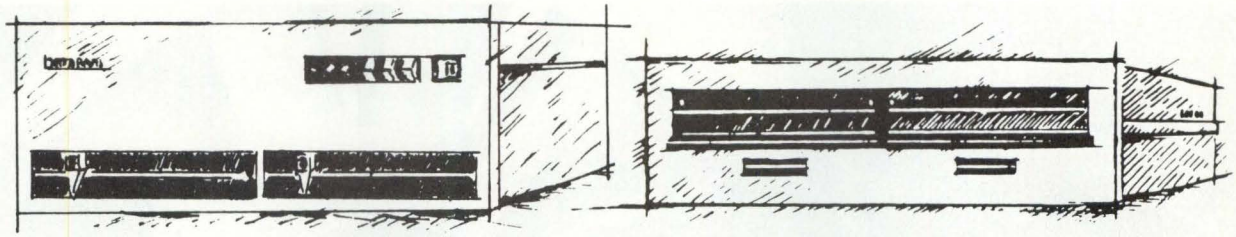
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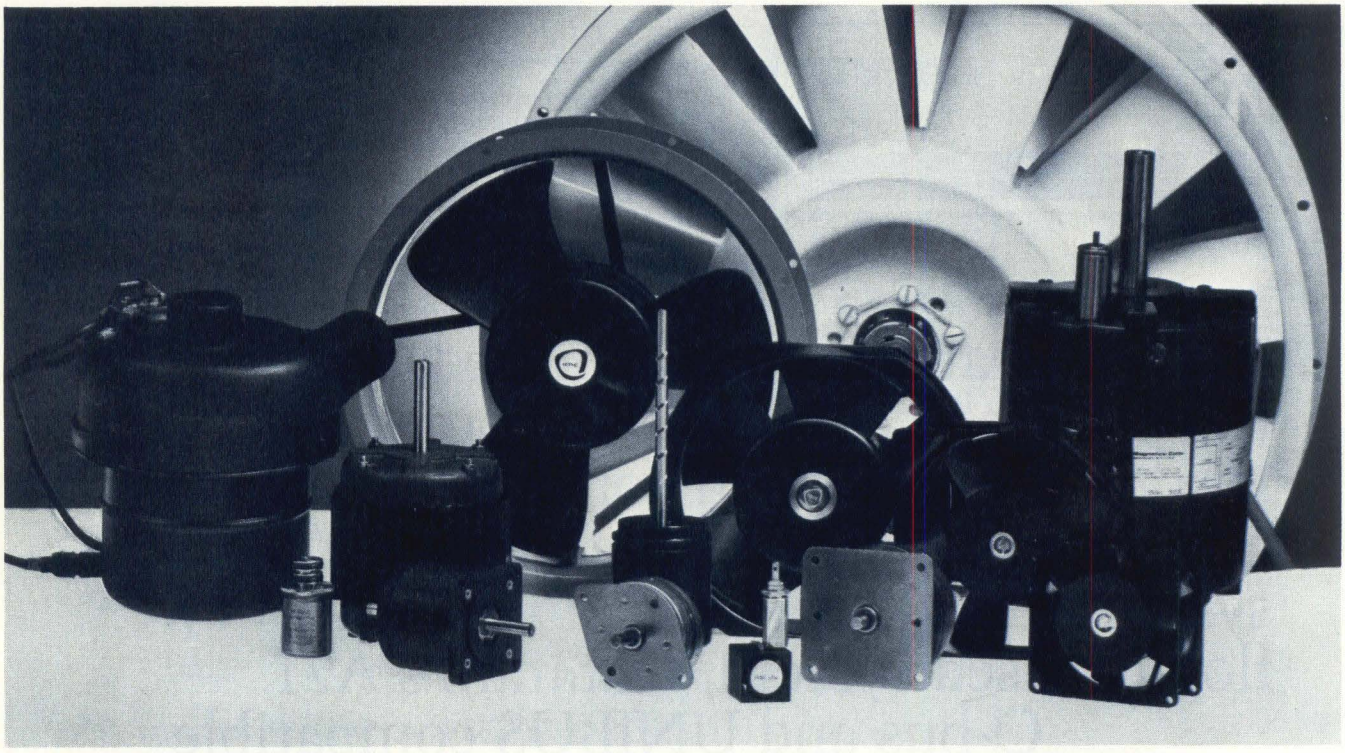
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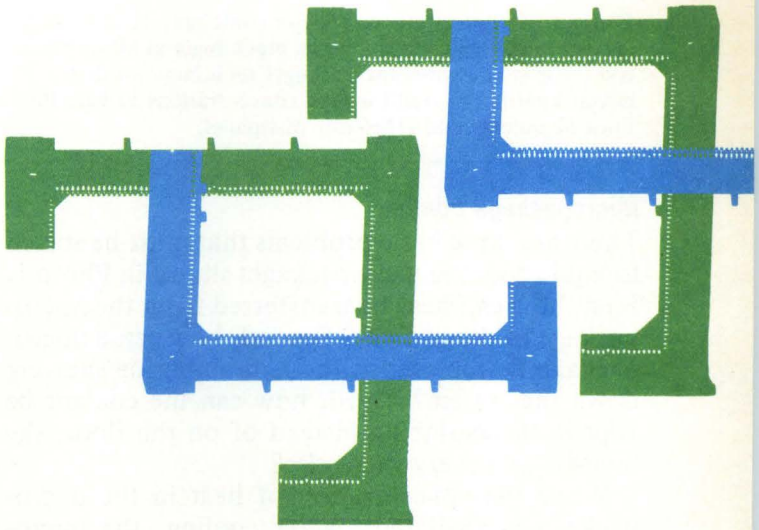
High density logic and low operating temperatures are not mutually exclusive in modern mainframe computers. In fact, heat can be removed from the densest logic assemblies by ordinary tap water circulating in a closed loop cooling system.

by E. A. Wilson

New methods of packaging, in use in large computer systems, are designed to allow close interconnection of both integrated circuits and printed circuit boards. In fact, the increase in packaging density over standard dual-inline packages on wire-wrapped or hard copper boards is often over ten-fold. However, with this increase in logic density comes a tremendous increase in power consumption per unit area and the accompanying problem of heat removal.

The comparative size of a micropackage containing current mode logic chips and a conventional printed circuit board containing transistor-transistor logic chips in dual-inline packages is shown in Photo 1. The 80- x 80-mm micropackage contains enough large scale integration chips to dissipate up to 60 W of power. One way to dissipate this heat is via convective air cooling. Unfortunately, there are several problems associated with this method of heat removal.

E.A Wilson is currently a principal staff engineer at Honeywell Information Systems, PO Box 6000, Phoenix, AZ 85005, where he is responsible for the packaging and cooling of large computer systems. Dr Wilson has a BSME from Newark College of Engineering, and an MS and a PhD in mechanics from Rensselaer Polytechnic Institute.



First, the volume of air needed to cool a large processor requires placing a blower in the processor cabinet. Hence, space that could be used for logic circuits is lost. Also, the necessary air ducts must be large in order to provide an acceptably low pressure drop and prevent the blow-by that accompanies a high momentum system. Such ducting also steals valuable space and forces longer interconnections between boards. In addition, the large volume of air and velocity required for needed heat transfer coefficients result in high noise levels. And finally, elaborate ducting and heat sinking limit access to the electronics, complicating repair.

An alternative to air cooling problems is to liquid cool the micropackages. High logic density can be maintained and the heat removal problem made manageable. This, in fact, is Honeywell's approach in its new DPS 88 family of large computers. These computers use current mode logic component micropackages.

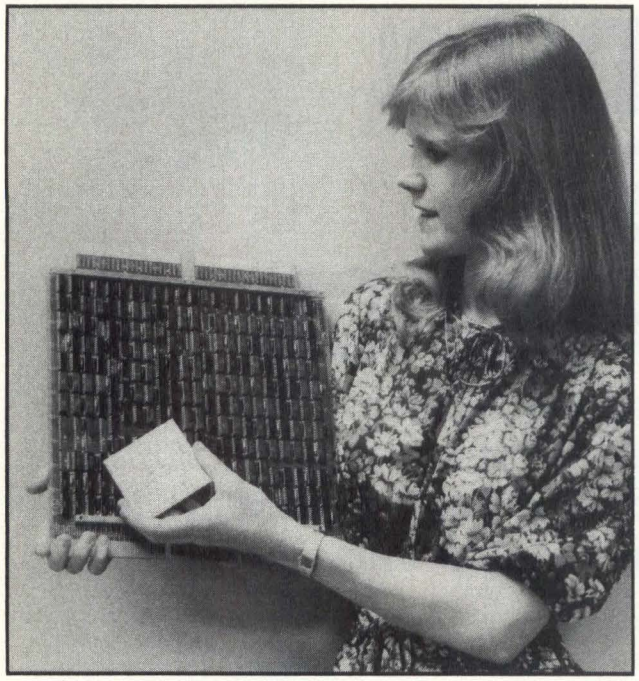


Photo 1 Compact micropackages containing Honeywell's current mode logic chips hold as much logic as all transistor-transistor logic dual-inline packages on a large printed circuit board. The result is high concentrations of heat that must be quickly and efficiently dissipated.

Micropackage cooling

There are three basic problems that must be solved to liquid cool the micropackages shown in Photo 1. First, how can heat be transferred from the micropackage to the coolant? Second, how can a micropackage be replaced without draining or shutting down the system? Third, how can the coolant be kept in the plumbing instead of on the floor, the boards, and everywhere else?

While the concentration of heat in the micropackage necessitated water cooling, the micropackage itself provided the design solution for these problems by obviating the development of the silent liquid integral cooler (SLIC). In many so-called liquid cooled computers, the liquid is actually used to pre-chill air, which then convectively removes the heat. The SLIC, however, brings the liquid in direct contact with the heat source, thus eliminating the inefficiency inherent in intermediate air cooling. This has a great impact on the design of the total system.

When pre-chilling air, extensive control must be placed on the computer cooling system and the user's computer room to prevent condensation from damaging components. In some cases, the user must supply the mainframe with finely controlled air. In fact, more exacting controls on temperature and humidity are required inside the computer, than in the computer room itself. By eliminating cooling air from the system, the liquid coolant can operate at a higher temperature—far above the dew point for the computer room. Simply, this reduces the condensation problem to one of coolant temperature control.

Where the SLIC is concerned, one remaining problem to overcome was obtaining excellent thermal contact between the smooth, but not necessarily flat, back of the micropackage and the SLIC heat exchanger. The solution was found in using a conforming surface that manifested itself as a 0.2-mm thick copper sheet. The SLIC cooling configuration is shown in the exploded view of Photo 2. As shown, three parts make up the SLIC: a blackened copper diaphragm, two blackened nipples, and a molded plastic back.

Copper and brass parts are given a black oxide surface by an acid dipping process, providing excellent wetting for epoxy bonding. The plastic back has baffles molded in the interior guaranteeing full coverage by the coolant circulating within its serpentine path. A hold-down ring is needed to press the micropackage into the electrical connector. This extra duty was also incorporated into the design of the plastic back. The entire assembly is epoxied and pressure tested after the cure cycle. The maximum pressure seen by the SLIC in service is only 35 kPa (1 psi equals 6.895 kilopascals), but every manufactured assembly is tested to 140 kPa to assure reliability. Life testing has demonstrated the long-term strength of the bonds to be great under worst-case shipping and field conditions.

Since the coolant is confined to the SLIC, and the SLIC is attached to the cooling system by flexible hoses acting as natural hinges, removal of a micropackage is possible without turning off the cooling

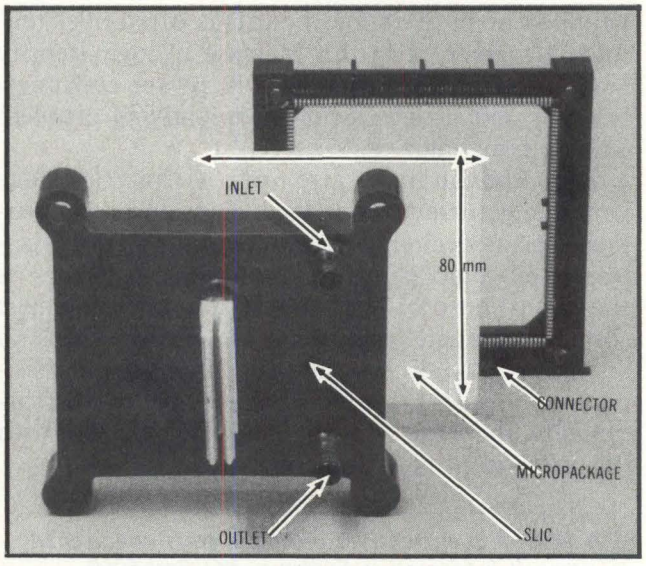


Photo 2 Shown are the basic elements of a silent liquid integral cooling assembly. SLIC provides efficient heat transfer from a micropackage to circulating water via a dry interface.

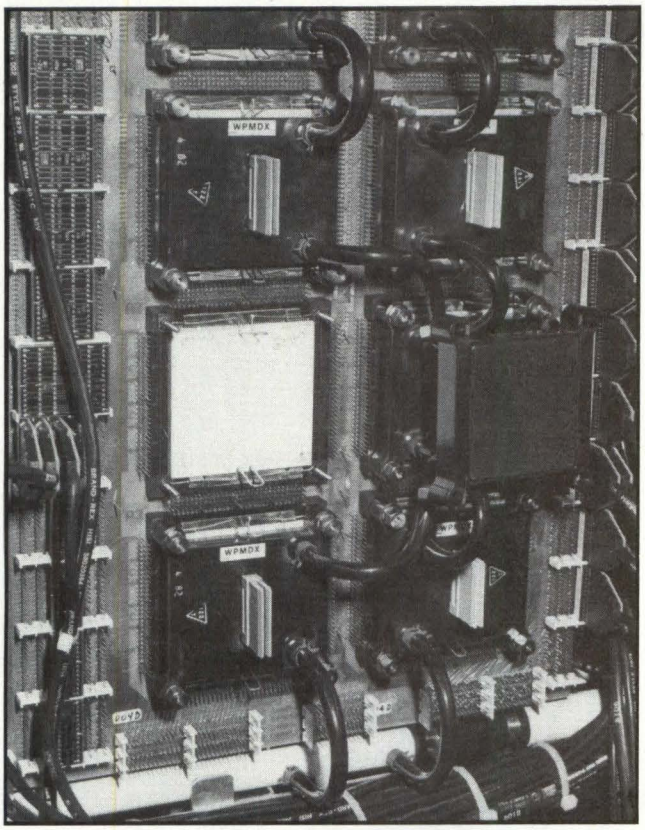


Photo 3 SLIC/micropackage assemblies are mounted in a 4 x 4 configuration on backplane boards. Flexible rubber hoses provide parallel flow paths and serve as hinges when the replacement of a micropackage is necessary.

system. The micropackage replacement operation in Photo 3 is performed while the cooling system operates. Severe environmental and long-term flexural cycling tests demonstrated no degradation of the mechanical properties of the polyvinyl chloride (PVC) tubing used as the SLIC hoses.

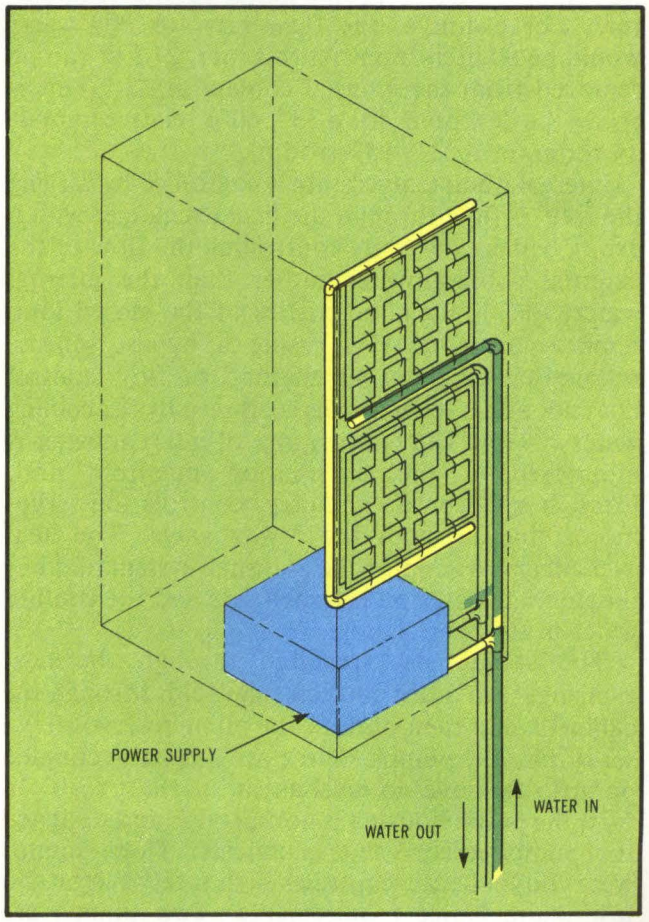
The cabinet plumbing is fabricated from standard PVC schedule-40 pipe and fittings, which hold 100 times the average pressure in the cabinet. PVC was chosen because of low cost, easy fabrication, and its high safety record. The reliability was further increased by using a 2-part acrylic adhesive for the joints instead of the more common solvent cements.

As seen in Photo 3, SLICs are mounted on backplane boards in four parallel rows with four serial SLICs in each row. In this configuration, a flow rate of approximately 1 liter/min per row maintains an average temperature difference of 8 °C between the water and the back of a 60-W micropackage. This is only half of the allowable temperature difference required to maintain an acceptable circuit temperature. By allowing for a safety margin of a factor of two, a contingency for pump failure is provided that ensures an adequate margin for reliable cooling.

Organization of components in the cabinet

The micropackages are mounted on printed circuit boards that serve as backplanes. The boards are arranged as shown in the Figure. Water enters the manifolds at the bottom of the top boards and flows in parallel through the rows of SLICs. Water is collected at the top, flows down to the bottom manifolds of the bottom boards, then through the rows of SLICs on all bottom boards. This top to bottom series arrangement allows the pressure due to the elevation above the bottom boards, and the pressure drop through the bottom boards, to offset each other. The result is that the pressure at the top and bottom boards is essentially the same. Thus, sufficient internal pressure for the topmost SLIC is achieved without necessitating higher pressure in the bottommost SLIC.

The level at which the coolant is at atmospheric pressure when it is not flowing is approximately midway between the top and middle boards. Above this, the pressure inside the plumbing, under no-flow conditions, is below atmospheric pressure since the air is automatically purged by the incoming



An example of a board and power supply arrangement within a main cabinet. A parallel flow scheme serves to equalize pressures within the cooling system.

coolant. A pressure switch is attached to the manifold running from the cabinet top to bottom. The only time the switch can sense an above atmospheric pressure condition is when there is sufficient back pressure. This would be caused by coolant flowing from the cabinet to the reservoir in an auxiliary cabinet. This monitored pressure switch automatically turns off the power supplies in any cooling loop that is not being adequately cooled. Not only the power supplies, but also the micropackages, are protected.

Cooling the coolant

It is inevitable that the coolant itself must be cooled. The system described allows two options: a water to water heat exchanger and a water to air heat exchanger.

The most efficient option is a water to water heat exchanger. The internal coolant for the computer (deionized water, treated to prevent corrosion and biological growth) is in a closed loop. The computer user provides external cool water for the heat exchanger from a water tower, a chiller, or a tap. Water temperature can vary 0 to 20 °C with flow rate approximately proportional to the temperature. For example, the flow rate for 20° water would be 80 liters/min. At this rate, 27 kW can be removed from the internal coolant at 32°. This is above the dew point for a 38°, 60% relative humidity room (or a 31°, 93% room).

Internal water temperature is controlled by varying the rate of flow through the heat exchanger with a 3-way bypass valve. By controlling the flow of the external cooling water rather than the internal water, the flow characteristics of the closed loop remain constant. Also, using a bypass scheme rather than a throttling method of flow control does not affect the pumping load seen by the cooling water system. The temperature of internal water is monitored at the distribution manifold and, through appropriate circuitry, controls the servomotor that actuates the 3-way valve. The heat exchanger is a simple tube and shell system that has the internal water on the shell side and the cooling water in the tube bundle.

The coolant is circulated through the heat exchanger, to a distribution manifold, through the cabinets, and then back to the inline reservoir by a set of parallel pumps. These are magnetic coupled pumps that have no mechanical or shaft seals. In fact, the pump housing is nonmetallic and designed for pumping corrosive chemicals. These pumps were chosen because of their high safety factor and low maintenance requirements. Two pumps are continuously operated in parallel to provide a fail-safe system. If the motor on one should fail, a check valve at the outlet prevents back flow through the failed pump. The remaining pump will provide sufficient flow for system cooling until the failed pump's motor can be replaced. This, by the way, can be done without removing the pump housing from the plumbing. The use of two continuously operating pumps avoids the need to turn on a standby pump when a main pump fails. Furthermore, the possibility of a standby pump not starting is eliminated.

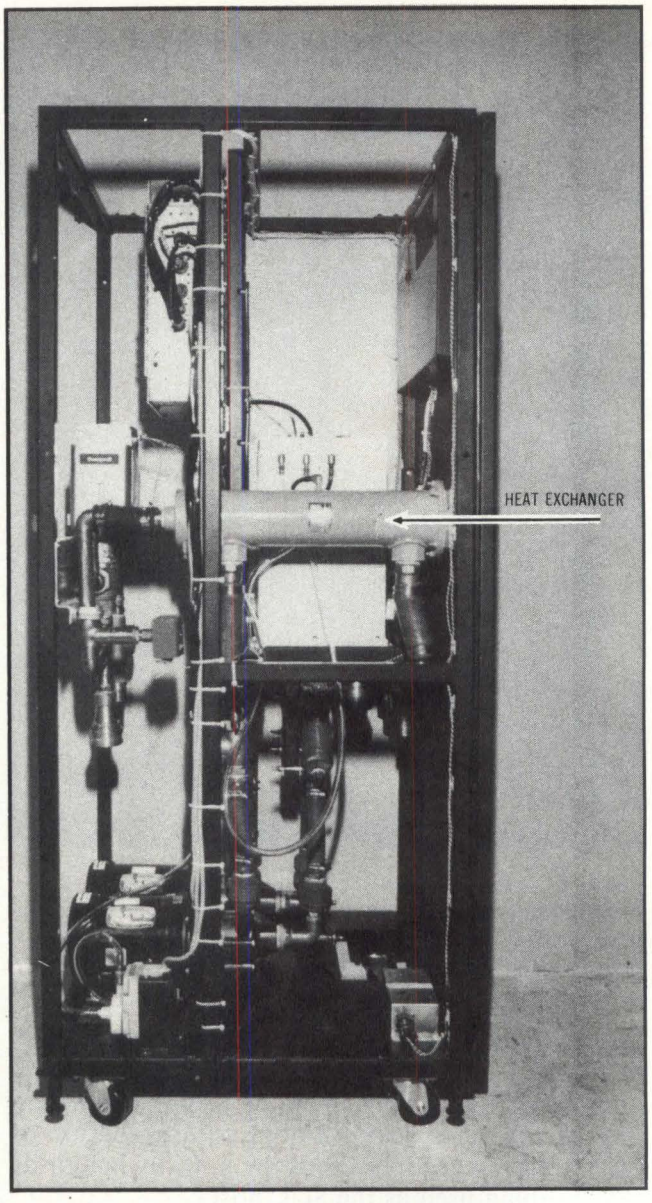


Photo 4 A remote heat exchanger unit contains pumps, bypass valves, and temperature and pressure monitoring circuitry.

The pumps, reservoir, and heat exchanger are located in a separate cabinet. This unit is shown in Photo 4. The automatic shut-off quick disconnects on the distribution manifold, and the bottom of the reservoir allows cooling loops to be attached or removed without shutting down the system. A pressure switch on the pump discharge manifold

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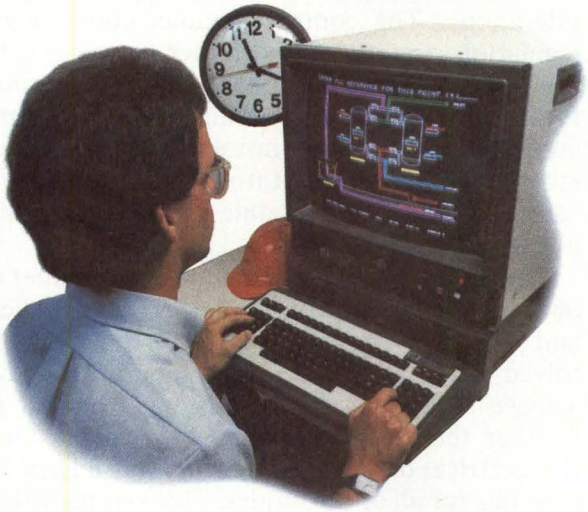
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CIRCLE 123

senses the pressure change when a pump stops operating. A pressure switch on the distribution manifold automatically turns off one pump if the design point manifold pressure (50 kPa) is exceeded. The total maximum system flow rate (all four cooling loops attached), with both pumps operating, is approximately 125 liters/min. The cooling control panel indicates external and internal cooling water temperatures. Pump operating status, reservoir level alarm and over/under temperature alarm and shutdown conditions are also indicated.

The second option for cooling the internal water is a room air heat exchanger. With this option, a version of the pump unit, without a water to water heat exchanger and temperature controlling equipment, is used with two auxiliary cabinets. Each of these auxiliary cabinets occupies the same floor space as that of a pump unit and contains a parallel air flow exchanger and multiple low speed blowers. This cabinet is not a refrigeration unit, but simply a relatively quiet water to air heat exchanger attached to the pump unit via reinforced flexible hose. With this unit, internal water temperature tracks the ambient air with an 8 °C difference. A maximum 40 °C water temperature (before alarm condition) is observed.

An obvious question is why is liquid cooling better than directly cooling the micropackages with room air? The answer is twofold. First, the plumbing space required in the logic cabinet is far less than that used by air ducts. Thus, denser logic packaging and shorter interconnection paths are present. Second, SLIC cooling effectiveness provides less than half of the temperature difference between micropackage and coolant than that obtained by an air heat sink. Since the design of a direct air cooling or liquid cooling system and its respective components is based on the highest power micropackage that can be used, the air required for direct cooling is much greater than that required for an average micropackage.

Through liquid cooling, micropackage powers are "averaged" before they reach the water to air unit where the air flow path is much less restricted than in logic cabinet air ducts. The combined resultant temperature differences between the air and the water, and then the water and the micropackage, are less than the air to micropackage temperature difference alone for direct air cooling. Also, the centralized cooling complex (consisting of the pump and water to air units) may be strategically placed in the computer room for optimizing room air management and reducing noise.

Admittedly, the water to air option is not as energy efficient as using a water to water exchange, but in situations where installing plumbing in a computer room is impractical, a water to air exchanger offers an alternative. By way of comparison, it is worth noting that for every dollar spent operating the computer, over 50 additional cents are spent operating the computer room air conditioning system. When an evaporative system is used to supply cooling water, this additional money can be reduced to as low as 14 cents for the liquid cooled portion of the system. Actual cost is dependent on climatic conditions, but water exchange will always cost less than injecting heat into a computer room's air conditioning system.

Power supply cooling

Liquid cooling accounts for 90% to 95% of the heat removal from system power supplies. This reduces air flow to the level where a small fan can provide adequate flushing air for resistors and capacitors. The power supply, providing 4000 W of regulated dc power, is composed of three modules. This 3-module approach reduces individual component weights and aids in maintainability. Module location was determined by the geometry of the cabinet rather than by any cooling considerations. The control module, containing the regulation circuits, provides user determined voltage options. The other two modules are common for all voltage designs. Thus, only the control module is unique to an installation. The capacitor module contains feed-through buses and filter capacitors. Both this module and the control module are air cooled.

The liquid cooled module (power module) contains the silicon-controlled rectifiers (SCRs), diodes, and reactors. The main problem that had to be solved for cooling the power supply was how to achieve a low cost, low resistance thermal path between the heat sources and the coolant. One of the electrical design requirements was a large common bus for all of the diodes. This was provided by using 12-mm thick aluminum plates that also serve as heat sinks for the diodes, reactors, and SCRs. Then, the usual problem of obtaining flat, smooth surfaces, as well as the problem of electrical isolation of the bus from the coolant, were both avoided by using a SLIC sandwich design. The entire power supply SLIC is soldered together and tested to over 500 kPa, ten times higher than the in-service pressure. Once this is assembled, there is no reason to disassemble it. SCRs must be electrically isolated from the diodes and each other. This is accomplished by mounting each SCR on a half-inch aluminum cylinder, which is in turn mounted into a hole in the large plate and held in place by cast epoxy in the annulus between them.

The power module is attached to the cabinet plumbing through automatic shutoff, quick disconnect fittings. Since the flow through all system elements in the cabinet is in parallel, the power module may be removed for service without hindering the cooling of any other parts. The flow design point is 2 liters/min. This is sufficient to keep the component temperatures 15 to 20 °C below the design limit. In fact, a 2:1 flow variation about the design point yields less than a 5° component temperature variation.

Water cooling, in addition to being able to remove more heat in a smaller space than air cooling, provides another major advantage: design compactness. During the development of the power system, it was discovered that if bus bars carried more than 750 A, mutual inductance effectively limited power supply output. This was overcome by making one aluminum plate a positive bus, the opposite plate a negative bus, and by using normal and reserve polarity diodes. The result is physically close, yet adequately wide buses exhibiting low inductance. Also, all internal wires from SCRs and diodes are short. Water cooling solved not only the heat problem, but an electrical problem as well. The result is a 4000-W power supply with tight regulation in an extremely small package.

High volume yields lower cost

The effectiveness of liquid cooling can be exploited on the large scale by designing a low cost, highly reliable system that can compete economically with direct air cooling. The forcing factor in Honeywell's DPS 88 system is micropackage power density. However, as cooling system concepts evolved it became obvious that liquid cooling surpassed direct air cooling in the areas of cost, noise, and reliability.

The prevalence of the SLIC provides enough volume to make in-house mass production of this specialized part practical. The extensive testing of each SLIC provides reliability assurance. PVC plumbing assemblies take advantage of the construction industry's volume to provide low cost, yet over-designed, materials. Other components, such as the pumps and heat exchanger, come from high use areas such as the chemical industry. Thus, they exhibit similarly low mass production costs and high reliability. The result of combining this disparate collection of parts is an efficient cooling system, conservative in both design and cost, while liberal in its ability to free heat from a hard running mainframe computer.

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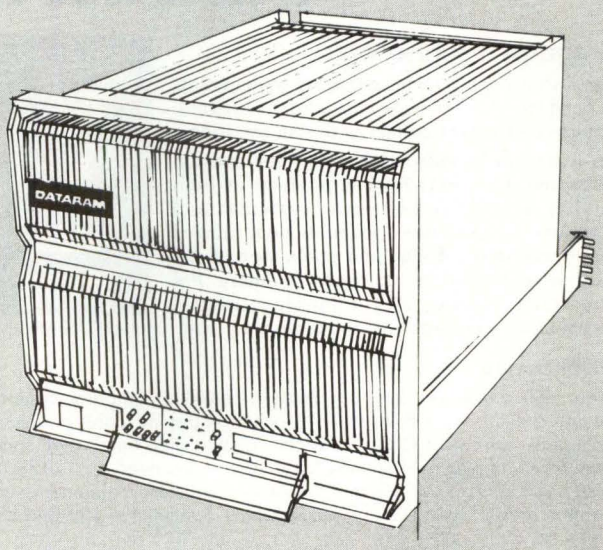
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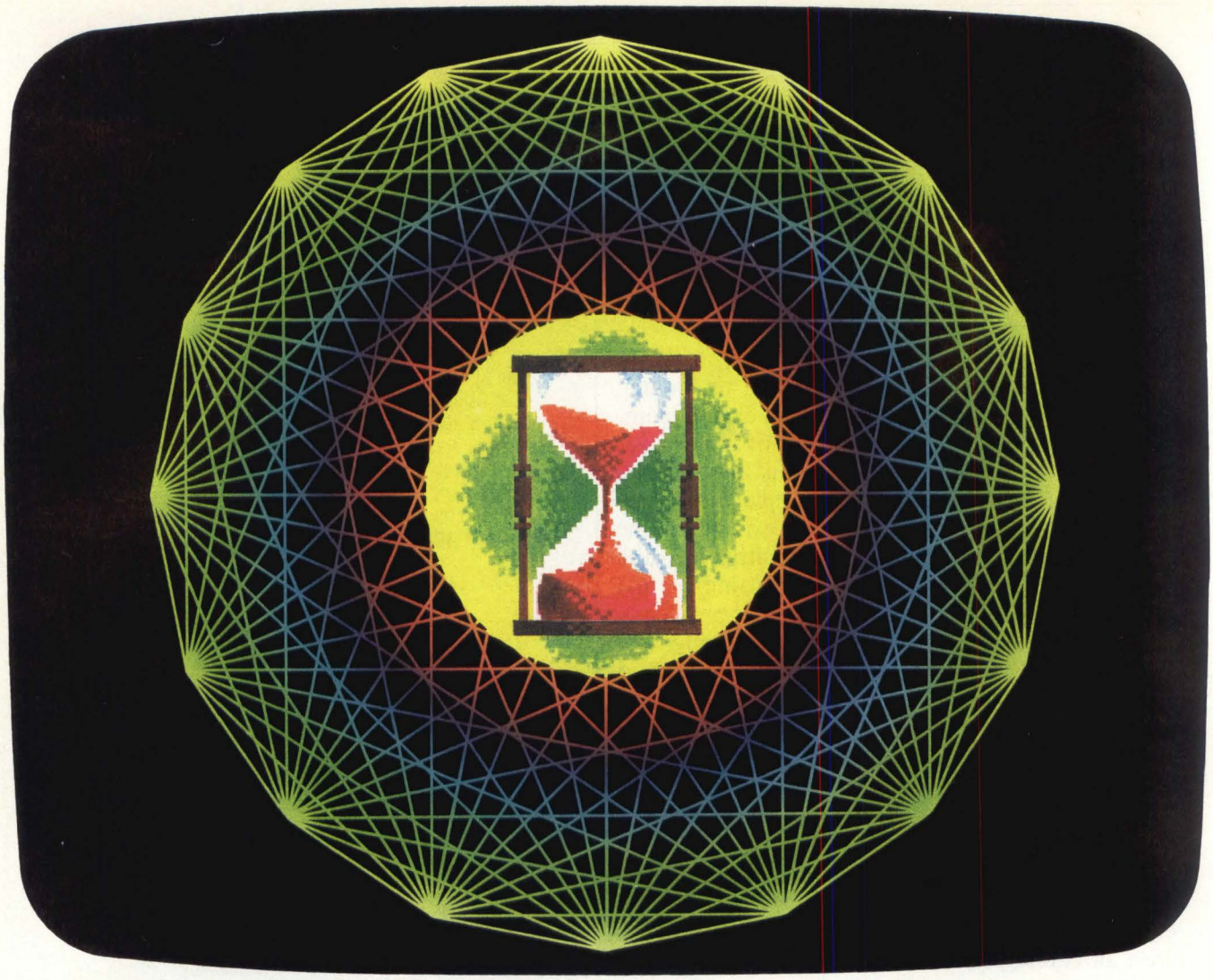
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SPECIAL REPORT ON

MASS STORAGE TECHNOLOGY

Multitudes of applications made practical by lower processor costs clamor for inexpensive mass storage. Quelling the uproar, magnetic storage devices are starting to fill demands on two fronts.

Floppy drives answer the need for lost cost bit storage by squeezing more bits onto each diskette. Smaller footprints with equivalent-sized drives enable these units to slide handily into business systems and portable instruments of all kinds. Flexible disks show no signs of slowing their progress, with future plans for them including adoption of vertical recording techniques—a move that promises quantum leaps in capacity over already substantial levels.

While interest centers on sub-4″ (micro) floppies, other media look to the future. Large capacity disk drives are adopting thin film heads and media to provide the higher storage capacities needed today. For archival storage, disks and magnetic tapes are threatened by the specter of optical recording. In the near future, optical disks will provide improved density, accessibility, and economy. At the present time, however, streaming magnetic tape drives are meeting the challenge of supplying low cost backup storage for disks.

System designers must choose from a multitude of alternatives. The opportunity to best fit the storage device to the application has never been greater, and ongoing standardization efforts forecast even better results. If its supporters have their way, adoption of proposed standards will render certain classes of devices relatively interchangeable. Designers will then be free to upgrade system performance at will.

Peg Killmon

Peg Killmon
Senior Editor

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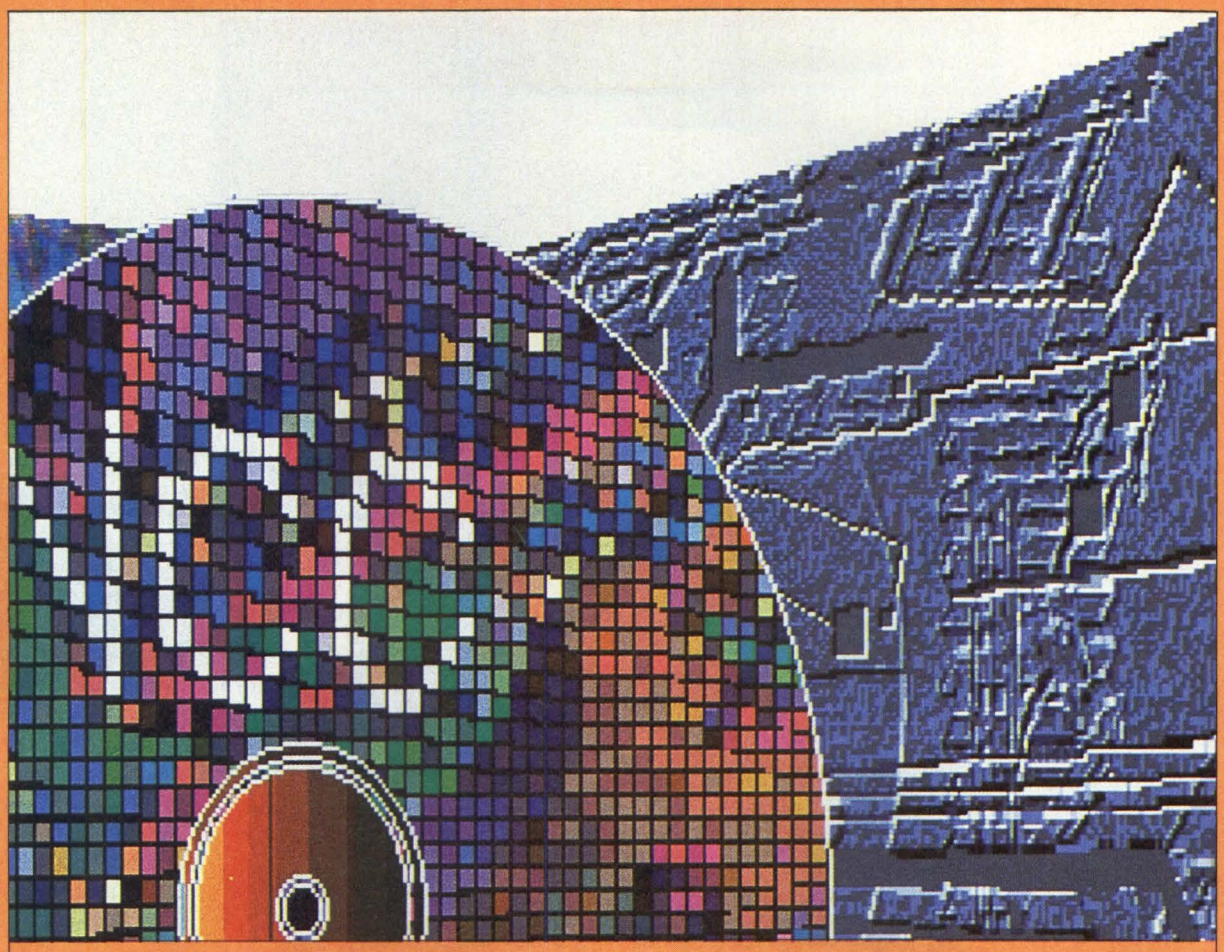
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Special report on mass storage technology

231 Tiny floppies squeeze in the bits
by Peg Killmon—Cramming performance into a small package, microfloppy drives promise to challenge cassettes' dominance in portable equipment.

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by Louis C. Domshy—By optimizing disk file formats and buffer memory schemes, system integrators can fine tune their machines for use with streaming cartridge drives. Beware, however; the throughput race does not always go to the swiftest.

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by Larry D. Hemmerich—Disk backup options are evolving almost as fast as the Winchester technology they strive to support. This overview of secondary storage highlights two of the most recent schemes.

267 Managing storage en masse with a shared server
by Ralph L. Platz, Robert C. Blackledge, and James H. Hughes—Incorporating parallel processing, bit-slice technology, and queued instructions into mass storage control has a dramatic result. A single server can attend to several host processors while overseeing scores of storage peripherals.



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CIRCLE 127



TINY FLOPPIES SQUEEZE IN THE BITS

Cramming performance into a small package, microfloppy drives promise to challenge cassettes' dominance in portable equipment.

by Peg Killmon, Senior Editor

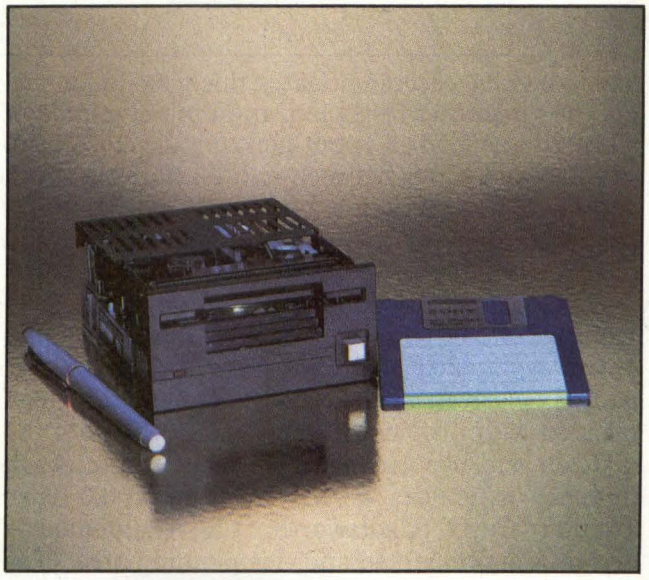
Capitalizing on both incremental and monumental advances in disk drive and related technologies, the microfloppy possesses those ingredients that guarantee success. The longtime darling of small computer systems, the flexible disk drive now packs more bits into a smaller package and promises still more.

These scaled-down drives respond to demands for high capacity and portability. They supply an 8″ drive's capacity in a package many times smaller. To achieve these ends, the drives grasped advances in technology as they emerged from the laboratory and put them to work.

In 1970, IBM (Boulder, Colo) solved its long-standing program loading problems by creating a limited storage capacity, removable media disk drive—the floppy or flexible disk. Today, floppy disks serve as the principal external storage medium for the multitudes of microcomputer based systems that require rapid random access to data. Marked by several double-capacity, half-size milestones, the floppies' evolutionary progression continues, with a monumental increase in capacity being demonstrated even as the first sub-5″ drives become commercially available.

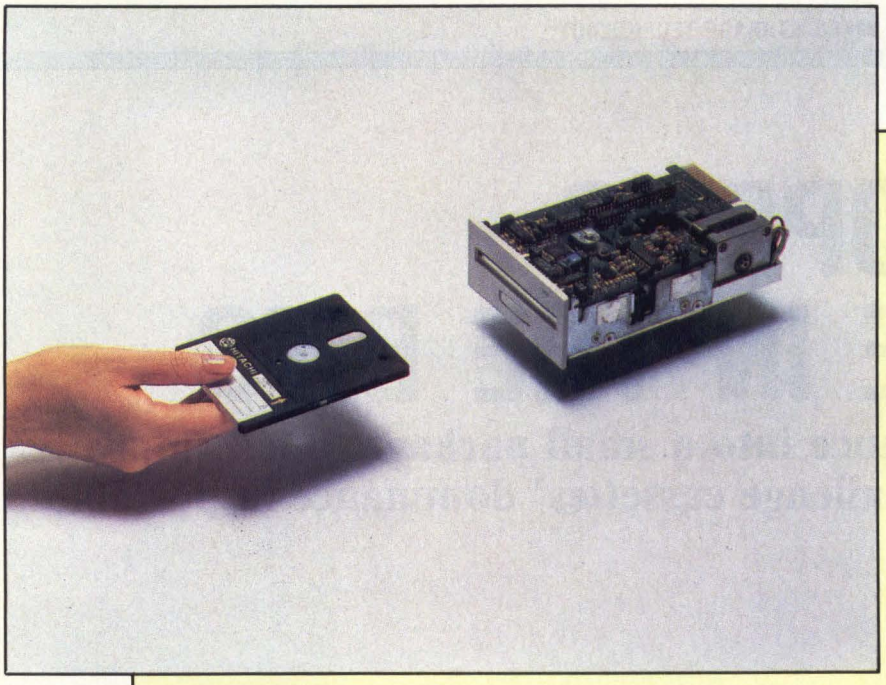
Growing in capacity

Early 8″ drives were limited to about 400k-byte capacity because they recorded on only one side and used frequency modulation (FM) recording techniques. FM techniques write a clock transition at the beginning of every bit cell. A data transition is present in the middle of the bit cell if the cell contains a 1 and is absent when the cell contains a 0. While the clock transition's existence makes the technique inefficient, it is satisfactory for densities up to 6400 flux changes per inch (fcpi), and at a 360-rpm rotational speed yields a 250k-bps data transfer rate.



First of the microfloppy genre, Sony's 3½″ microfloppy packs 437.5k bytes on a single-sided diskette using 135-tpi and 7610-bpi density. Hard shell cartridge has been widely accepted since it offers the protection deemed necessary for the medium.

Increases in capacity came about when makers used the modified frequency modulation (MFM) recording technique to double recorded bit density.



Hitachi's compact floppy disk drive writes on 3″ hard shell medium. Media package complies with Japanese postal regulations to cut mailing costs.

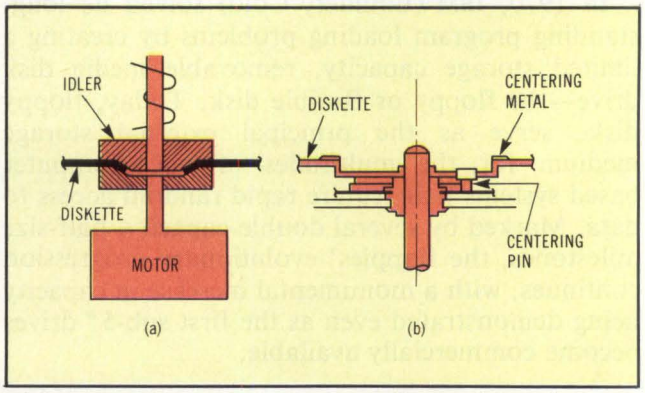
MFM encoding accommodates this gain by changing the direction of magnetization in the middle of a bit cell to encode a 1, but omitting the clock transition. When a 0 is between two 1s, both the clock and data transition are omitted. This results in twice the data density without increased circuit complexity.

Double-sided recording brought capacities up to 1.6M bytes, but required a change in head technology. Development of a dual head, begun by IBM, had a marred record. First design attempts, plagued with problems, turned out to be both too difficult and too expensive to manufacture. Most of these difficulties were overcome in 1980 when Tandon Corp (Chatsworth, Calif) patented a design using one fixed and one pivoting head. The result has proven to be easily produced and cost effective, leading independent vendors to use it in their drives.

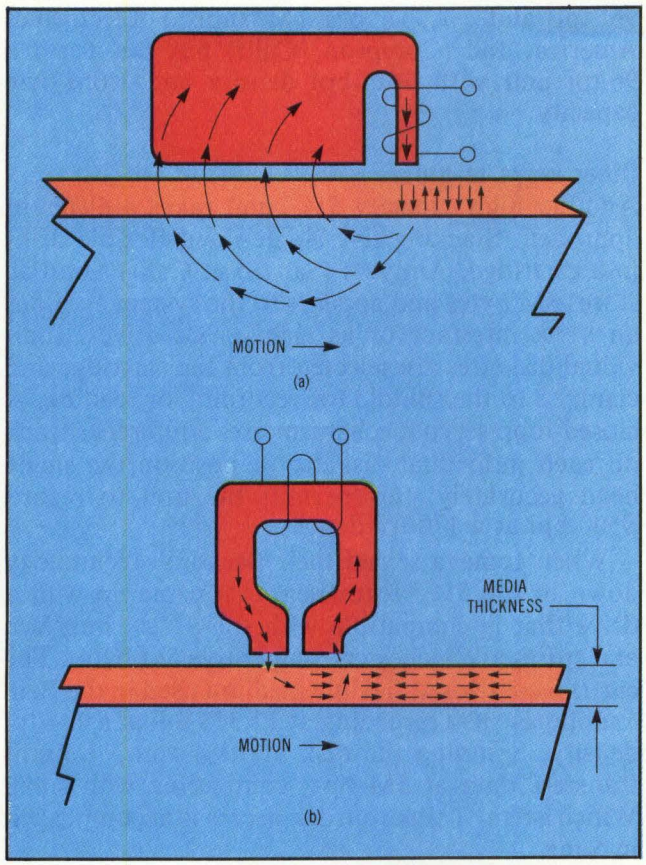
Further increases in capacity require an increase in track or bit density. Easier said than done, increasing bit density requires the disk to spin at higher rates to raise the data transfer rate. Raising the track density requires that track width be reduced. Both requirements pose concomitant problems.

Increasing the data transfer rate increases the complexity of controller electronics; making tracks narrower makes it harder for the head positioning mechanism to find and stay on the track. In 8″ disks, the distortion of the Mylar medium caused by heat and humidity compounds the tracking problem. One method of overcoming this problem is to resort to closed-loop servo systems. By reading embedded servo data as the head moves from track to track, a system such as this continually corrects the head positioner for any distortion evident in the medium. Iomega Corp (Ogden, Utah) uses this technique on its 8″ Alpha 10 and more recent 5¼″ Beta 5 drives. When combined with the drives' aerodynamically based design, servo positioning permits 18k-bpi densities to be reached for a formatted capacity of 10M bytes.

Although more expensive and complex, closed-loop servo systems do provide the tracking accuracy necessary if track density of flexible media is to be increased. The technique is under scrutiny at



Diskette centering techniques. Typically the diskette's center hole is positioned over the spindle and is fixed into position by a mechanism that drops down on it (a). Sony's drive uses a metal hub on its diskette that contains a centering hole (b). This hole mates with a pin on the spindle to guarantee accurate centering.



Vertical versus longitudinal recording. To squeeze more bits into a linear inch, vertically oriented media stand magnetic particles on end (a), whereas longitudinal methods lay them on the substrate's surface (b).

several sites. Both Burroughs Corp (Detroit, Mich) and others are reportedly working on drives that will supply 5M-byte capacities using servo techniques with 8″ flexible media. The lack of readily available media having embedded servo data, however, may slow the release of this type of product.

Two in the space of one

Supplying an attractive alternative to standard 8″ drives while filling demands for added capacity, half-height models offer the same capacity in half the volume, or double the capacity in the same space. Many of these half-height units, in addition to cutting space requirements, offer stepped-up performance as well as longer maintenance-free lifetimes.

Development of these chopped and channeled units depended on motor technology advances. By replacing the ac motor used to drive the spindle with brushless dc motors, manufacturers saved considerable space. These motors are one-fourth as thick as the ac units they replace and occupy one-fourth the volume. Moreover, using the motor to direct drive the spindle can eliminate the need for belts and associated mechanisms previously used to accomplish this task. Custom large scale integration circuits supply the precision speed control functions for these motors, offering the added benefit of control right on the drive board.

Stepper motors necessary to perform head positioning functions have been reduced to 60% of their former size. Another bonus is that their improved mechanical tolerances enable more accurate positioning. In addition, their faster stepping rates cut access time in half. When combined, these techniques not only reduce space requirements, but raise reliability by eliminating failure-prone mechanisms, connections, and components within the drives.

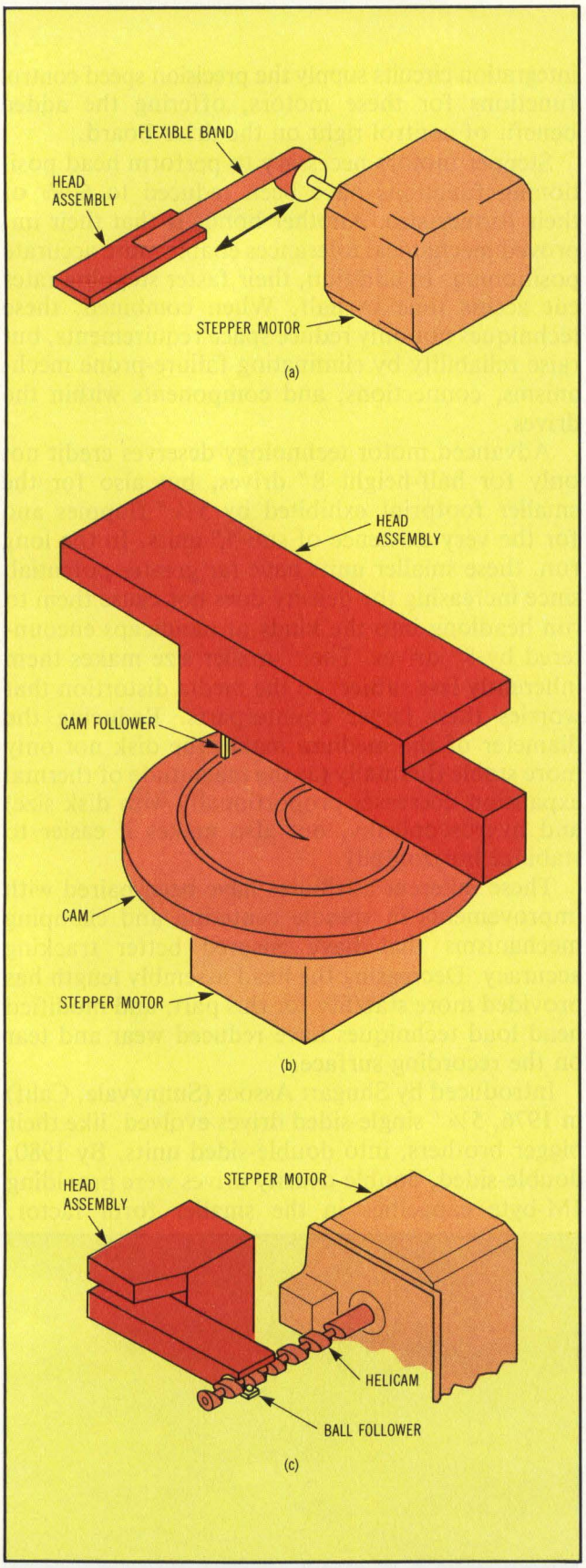
Advanced motor technology deserves credit not only for half-height 8″ drives, but also for the smaller footprint exhibited by 5¼″ floppies and for the very existence of sub-5″ units. In the long run, these smaller units have far greater potential, since increasing the density does not cause them to run headlong into the kinds of handicaps encountered by 8″ drives. Their smaller size makes them inherently less subject to the media distortion that worries their larger counterparts. Reducing the diameter of the medium makes the disk not only more stable thermally (as the magnitude of thermal expansion decreases proportionally with disk size) and hygroscopically, but also makes it easier to stabilize horizontally.

These inherent attributes have been paired with improvements in spindle centering and clamping mechanisms that have ensured better tracking accuracy. Decreasing the head assembly length has provided more stability for this part, and modified head load techniques have reduced wear and tear on the recording surface.

Introduced by Shugart Assocs (Sunnyvale, Calif) in 1976, 5¼″ single-sided drives evolved, like their bigger brothers, into double-sided units. By 1980, double-sided, double-density drives were providing 1M-byte capacities in the smaller form factor.



SA300, Shugart's initial microfloppy, stores 500k bytes using single-sided recording and handles data transfers at 250k bits/s. Both drive and medium conform to the Microfloppy Industry Committee's proposal.



Head positioning mechanisms. Key to the accuracy needed for higher track density diskettes such as the sub-5″ units, the flexible band positioner (a) claims to supply the fastest, most accurate positioning. Spiral cam (b) and lead screw (c) positioners are also commonly used.

Micropolis Corp (Canoga Park, Calif) has attained 2M bytes on a double-sided drive by recording at 96 tpi and 11,937 bpi. Mitsubishi Electronics America, Inc (Compton, Calif) has put forth a 96-tpi unit with 9621-bpi density and 1.6M-byte capacity.

Other ways to grow

Another high capacity 5¼″ unit takes a different approach. Stacking five single-sided flexible disks in a cartridge, Amlyn's (San Jose, Calif) MiniPac stores 8M bytes and appears to the system as either an ST506 interface or as eight SA850 drives. Individual diskettes are selected from the cartridge and clamped to the spindle for recording or reading. A closed-loop servo mechanism uses a reference track on each individual diskette to position the single head accurately; this permits the unit to record 9500 bpi at a 170-tpi density.

When Iomega scaled their Bernoulli technology down to the 5¼″ form factor, it came up with a drive that is compatible with the ST506 interface and stores a Winchester-competitive 5M bytes. The cartridge-enclosed flexible medium used in the Beta 5 supports MFM recording at 17,373 bpi at a 434-tpi density. Spinning the disk at 1964 rpm, the unit transfers data at 5M bps, compatible with small Winchesters. Track to track access is accomplished in 5 ms.

More conventional in form, Drivetec's (San Jose, Calif) SuperMinifloppy packs 3M bytes into a half-height 5¼″ form factor. Although the form factor is conventional, the means of achieving this capacity is not. A combination of a track following embedded servo system, a 2-stepper head positioning system, and an absolute vertical clamping mechanism are key to this performance.

The embedded servo system not only allows recording at 192 tpi on double-sided diskettes prewritten with servo bursts, but also acts to ensure diskette interchangeability between drives in different systems or environments. The positioning system uses one stepper for relatively large movements of the head while reserving the second for the precise adjustments that center the head over the track. Heads can be moved in increments of 200 μin. To ensure alignment, the unit incorporates an absolute vertical clamping mechanism that results in accurate, repeatable diskette registration.

Constant areal density raises the capacity of the floppy drives incorporated in Apple's Lisa. These drives record at a constant density of 10k bits/linear inch on 62.5 tpi to put 860k bytes on each diskette. In these drives, Apple (Cupertino, Calif) also uses microstepping algorithms on the stepping motor to move the heads in minute increments; this allows the heads to move in fractions of a track width when searching for the exact middle of the track.

Pushing densities beyond the levels already attained demands more of the recording media, heads, and positioners.

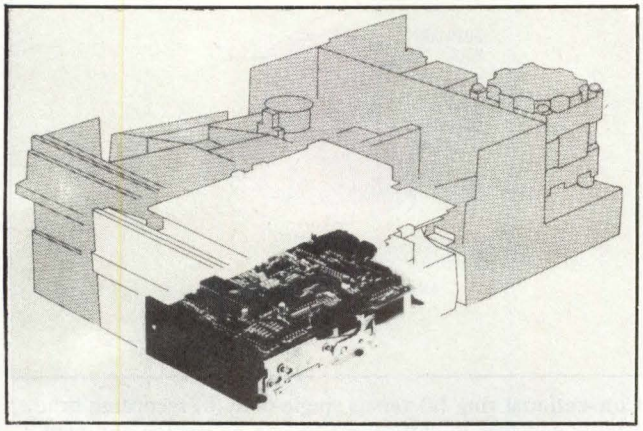
Recording heads in this unit, unlike those in other double-sided drives, are not located directly opposite one another. In this drive, a pressure pad achieves contact between recording medium and recording head by applying force on the medium from the side opposite the head, as in conventional single-sided floppy drives.

While not so dramatically, density can also be increased without resorting to advanced techniques by putting two drives in the place of one. Half-height 5¼" drives can double the available capacity using regular media without a change in the basic package. Another bonus obtained with half-height units is the ability to use both Winchester and backup floppy in systems.

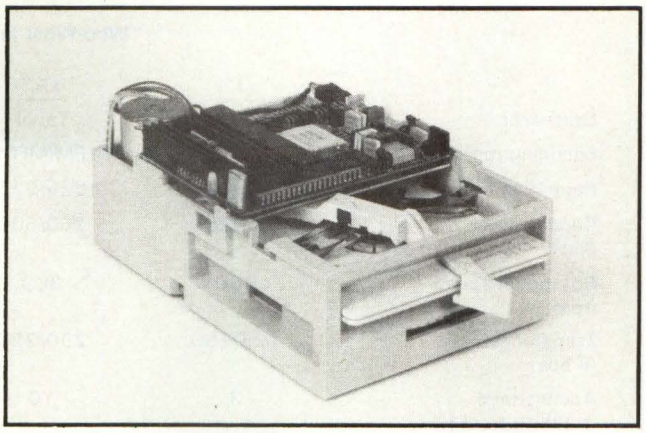
Testing the limits

Pushing densities beyond the levels already attained, however, demands more of the recording media, heads, and positioning mechanisms. Tightened criteria for media have caused manufacturers to move to high coercivity formulations to coat the substrate. The recording surface, traditionally applied by a web coating process, contains particles with magnetic properties that greatly affect floppy disk performance.

Progress depends on the development of thinner, better dispersed and oriented particulate coatings, or of very thin plated or sputtered films. Higher resolution coatings on standard 5¼" substrates are being produced by 3M Co (St Paul, Minn) which uses a high energy formulation on 3-mil polyester to provide an areal density of 7.5M bits/in^2. Maxell



Microfloppy disk drive in Tandon's 3½" form factor (photo inset) occupies one-eighth the volume of an 8" drive (shaded area), but stores more than one-half the quantity of data.



Varying the spindle speed as the recording head moves from inner to outer tracks lets IBM put data down at a constant 6865-bpi density. This method packs 358 bytes onto the single-sided 4" diskette's 46 tracks.

Corp of America (Moonachie, NJ) coats diskettes with an epitaxial magnetic material produced from gamma hematite with cobalt ferrite. Verbatim (Sunnyvale, Calif) produces a high density diskette by putting a 50 μin 625-Oe coating of cobalt impregnated gamma iron oxide down on the substrate. Dysan Corp and Brown Disc Mfg (Santa Clara, Calif and Colorado Springs, Colo, respectively) plan to produce spin-coated disks. Spin coating provides higher potential bit density by supplying smaller particles. The technique achieves a potential of 15k-bpi linear density with a 200-tpi density.

Dysan's spin coating process closely controls the density of cobalt surface modified iron oxide particles on the substrate, producing diskettes with a 600-Oe nominal coercivity and 940-gauss nominal remanent magnetism. While providing higher potential bit density by supplying smaller particles, the material's higher coercivity requires that read/write (R/W) heads provide a write current about 2 mA higher and a proportionally higher erase current than is necessary for standard media.

To combat the negative aspects of higher track and bit density, head manufacturers have shifted their technology. Heads being used to read and write the extremely dense data on newer media are now typically formed of manganese zinc ferrites, and they record on cobalt doped coatings. Shugart uses a ceramic R/W head with straddle erase elements to erase areas between data tracks. C. Itoh (Los Angeles, Calif) sets R/W and erase gaps by azimuth to trace the track curvature and to precisely define the border between recording and nonrecording areas on each track. IBM uses a single head that performs both R/W and tunnel erase functions. Trimming the tracks with this function eliminates crosstalk between tracks.

Who/What in Sub-5″ Arena

	3″	3¼″	3½″	3½″	4″
Originator	Hitachi	Tabor	Sony	Tandon	IBM
Encoding method	FM/MFM	FM/MFM	FM/MFM	FM/MFM	FM
Recording density (bpi)	4473/8946	4625/9250	3805/7610	3128/6255	6865
Capacity/side (kilobits unformatted)	125/250	250/500	218.8/437.5	125/250	358
Rotational speed (rpm)	300	300	600	300	262 to 415
Transfer rate (k bps)	125/250	250/250	250/500	125/250	333
Access (ms) (track to track)	3	10	15	3	40
Tracks/side	40	80	70	40	46
Tpi	100	140	135	135	68
Sides	2	1	1	2	1
Compatible with 5¼″ minifloppy	Yes	Yes	No	Yes	No
Media cover	Hard	Soft	Hard	Hard	Hard (2-piece)

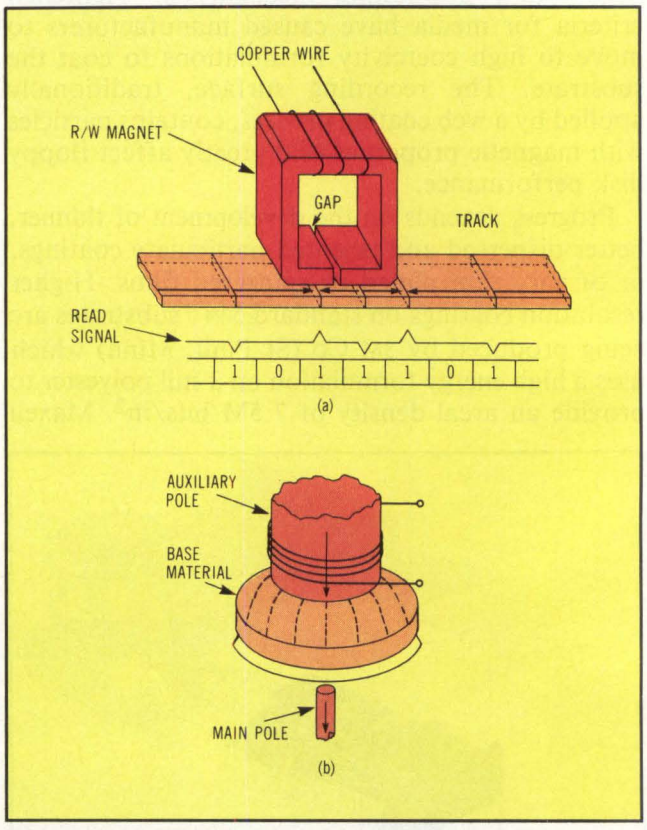
Head positioning is another critical area when dealing with higher track densities. To accurately position the heads to record 9646 bpi on 96 tpi, C. Itoh uses a steel band and 8-pole stepper. Micro Peripherals Inc (Chatsworth, Calif) uses a split-band mechanism directly driven by the stepper. Tabor Corp (Westford, Mass) has a drive that relies on a stepper motor lead screw actuator to write at 140-tpi density. Shugart positions the R/W head assembly using a spiral cam that the stepping motor rotates in discrete increments.

Most of the sub-5″ manufacturers have inserted a metal or hard plastic center hub in their media to eliminate eccentricity or wear that leads to inaccurate track positioning. This hub also promises to provide more accurate centering and to eliminate chucking errors.

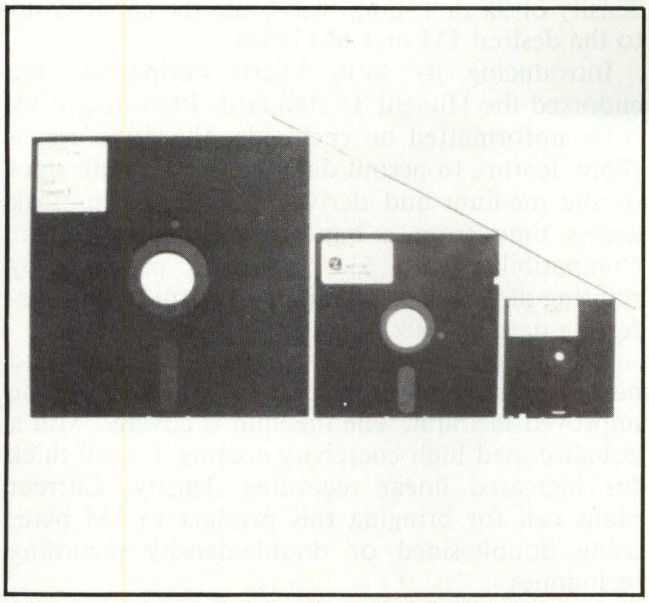
The micro dimension

Following the trend toward smaller drives, a crop of sub-5″ drives began popping up about two years ago. Oddly enough, the initial offering came not from IBM or any other traditional disk manufacturer, but from Sony Corp (Paramus, NJ). Although being first has customarily been enough to guarantee *de facto* standardization, this has not proven true with Sony's drive. U.S. manufacturers, for whatever reasons, have not flocked to adopt the product. Even worse, there seems to be less consensus now on what size constitutes micro than there was even three months ago, though industry observers maintain that having so many form factors can only slow the microfloppy drives' start up.

Although Hewlett-Packard (Palo Alto, Calif) has chosen to package Sony's drive in a trio of disk drive products, Sony's original design, in the eyes of most U.S. manufacturers, had several flaws. It recorded on 70 tracks in double-density mode, stored 437.5k bytes unformatted on one side, rotated at 600 rpm, and used a 100-μm thick media



Conventional ring (a) versus single-pole (b) recording head. Higher densities in vertical media can be written and read using single-pole heads. Although capable of reading/writing vertical media, a conventional head cannot attain full potential of these media.



The 3¼″ medium used in Tabor's Drivette is one-fourth the size of familiar 8″ diskettes, yet holds half as much data using current technology. Capacity of the 3¼″ medium is equivalent to that of 5¼″ floppy media.

coating. Even more grievously, it did not conform to the industry standard 5¼″ interface.

To prevent a recurrence of the stalemate that existed when 8″ Winchesters came to market without a standard interface, an unofficial voluntary committee of disk drive and media vendors attempted to standardize on a form factor for the so-called microfloppy drives. The Microdisk Standards Committee (MSC) looked at announced products, performed market surveys, and recently presented their views in a proposed standard to the ANSI X3B8 committee. Those dissatisfied with this group's recommendations have formed two splinter groups. There are now three proposals before the ANSI committee: one deals with the 3½″ form factor, one with the 3¼″, and one with the 3″.

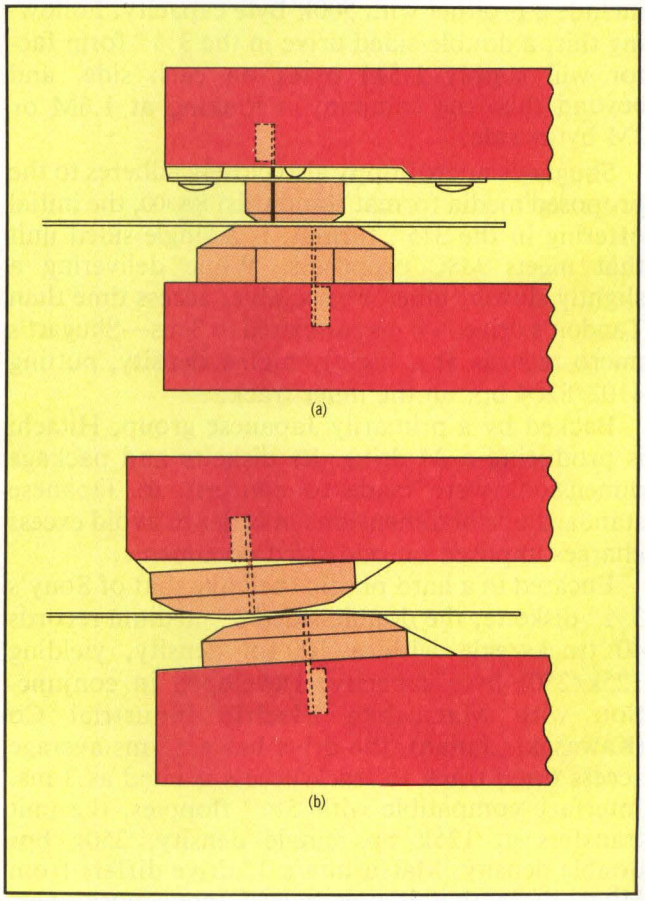
Most manufacturers interested in producing the microfloppy agree that for the interface, SASI is clearly the winner; size, however, is another matter. And, as it turns out, so is the package. The size, format, and package that will come to dominate is not clear. However, the major players to date are Sony, Hitachi (Allendale, NJ), and Tabor Corp; a more recent entry is IBM.

Although Sony's original unit did not match the unofficial committee's standards, it will in a modified version. To accomplish this, Sony has agreed to change to a double-sided disk with 80 tracks to provide compatibility with 5¼″ disk formats. The company has agreed to provide a positive closing action on the shutter for the head access window within the diskette's hard plastic protective jacket.

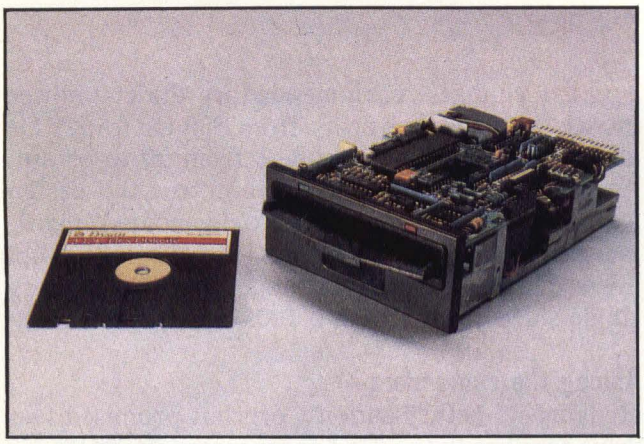
Other changes recommended by the committee increased media coercivity from 580 Oe to 625 Oe and reduced coating thickness from 90 to 65 μin. As proposed to the ANSI committee, the design would be based on a 3½″ oxide-coated, hard-jacketed diskette. It would provide 136-tpi, 8178-bpi linear density, 500k-byte storage capacity, 80-track single-sided format, and a 500k-bps transfer rate.

Among the contenders

Hedging its bets, Tandon Corp has promised two drive families in the 3½″ form factor. Its TM35-4 is interface and media compatible with Sony's unit and the TM35-2 is interface and software compatible with standard 5¼″ minifloppies. The TM35-2 is a 5¼″ look-alike with 40-tracks/side, double-sided recording, a 250k-bps transfer rate, and 500k-byte capacity. Rotating at 300 rpm, the unit has a 3-ms track to track access time. The TM35-4, while compatible with Sony's OS-D30V, caters to the U.S. market by recording on both sides of the disk at 7610 bpi.



Double-sided recording heads. In a typical recording head (a), the top side is pressed against the medium by another directly opposing head on the bottom side. Drivetec's gumball head configuration (b) rounds the edges and offsets the heads to reduce media wear.



TC 500 Drivette accommodates smaller 3¼″ form factor media. Low cost goals are met by manufacturing the drive of snap-fit parts and by using a traditional soft jacket on the diskette.

Just introduced extensions to this family expand capacities to 1M bytes. Models TM35-1, a 5¼″ look-alike, and TM35-3, a Sony compatible drive, use double-sided recording to add capacity while retaining other features in common with their predecessors.

In addition to its 427.5k-byte unit, Sony's plans include a product with 500k-byte capacity. Following this, a double-sided drive in the 3½″ form factor will supply 1.5M bytes on each side, and beyond this, the company is looking at 1.6M or 2M bytes/side.

Shugart's microfloppy also closely adheres to the proposed media format standards. SA300, the initial offering in the 3½″ format, is a single-sided unit that meets MSC proposals. While delivering a slightly slower, albeit respectable, access time than Tandon's drives—6 ms compared to 3 ms—Shugart's micro records at a slightly higher density, putting 4102/8204 bpi on the inner track.

Backed by a primarily Japanese group, Hitachi is producing a 3″ drive. Its diskette and package dimensions were made to conform to Japanese standard postal dimensions in order to avoid excess charges imposed on odd-sized documents.

Encased in a hard plastic shell like that of Sony's 3½″ diskette, the double-sided 3″ medium records 40 tracks/side with a 100-tpi density, yielding 125k/250k-byte capacity. Developed in conjunction with Matsushita Electric Industrial Co (Kawasaki, Japan), the drive has a 55-ms average access time; track to track access is cited as 3 ms. Interface compatible with 5¼″ floppies, the unit transfers at 125k bps single density, 250k bps double density. Matsushita's 3″ drive differs from Hitachi's in that it uses a lead screw positioner. This raises track to track access time to 20 ms.

Plans are underway to bring this drive to 1.6M-byte capacity. To achieve this, the diskette substrate will exhibit improved thermal and hygroscopic characteristics. This will permit double recording on 80 tracks/side at 200 tpi. Bit density of 9k or 15k bpi will bring the capacity up to the desired 1M or 1.6M bytes.

Introducing its 301F, Micro Peripherals Inc endorsed the Hitachi 3″ standard. Providing 250k bytes unformatted on each side, the drive uses a flippy feature to permit data storage on both sides of the medium and derives 3-ms track to track access time from a band-type head positioner. Compatibility with 5¼″ drives is provided by rotating at 300 rpm, writing at 100 tpi, and transferring data at 250k bytes/s.

A manganese zinc head with wide R/W gap and narrow erase gap uses the density attained from the improved medium. The medium is covered with a cobalt-doped high coercivity coating 1.1-mil thick for increased linear recording density. Current plans call for bringing this product to 1M bytes using double-sided or double-density recording techniques.

Consensus is that the 3″ medium has limitations. Since most vendors and potential users agree that obtaining compatibility with 5¼″ floppies is the goal, most also agree that the 3″ media must push technology to achieve it.

The 3.5″ diameter has twice the recording surface of the 3″ size; 4″ diskettes supply more recording surface, but lack the shirt-pocket size factor and offer little incentive to make the switch from 5¼″ units. Small enough to fit into a shirt pocket, the 3½″ package remains large enough to store 1M byte recorded using mature positioning mechanisms. This allows upgrades to occur as improved media and positioning mechanisms become readily available. The point of agreement is that reliability is more important than small incremental reductions in size. There are, however, those that maintain that size is the factor to consider—the smaller the better. And the design does have supporters. Amdek Corp (Elk Grove Village, Ill) is putting two of Hitachi's 3″ drives in a package that supplies 1M-byte capacity. Aimed at the personal computer market, the Amdisk-3 provides compatibility with 5¼″ units at a $799 retail price.

Presenting yet another proposal for ANSI consideration, Tabor Corp, itself a newcomer to the industry, sponsors a 3¼″ unit that, unlike the others, uses media protected by the now familiar soft vinyl diskette jacket. The single-sided drive records using either FM or MFM techniques at a 140-tpi density. Bit density is 4625 or 9250 bpi and data transfers occur at 250k bps (FM). Capacity is 500k bytes using MFM recording techniques.

Tabor seems to be counting on a relatively simple manufacturing process and potentially unlimited availability of low cost media to make its unit come

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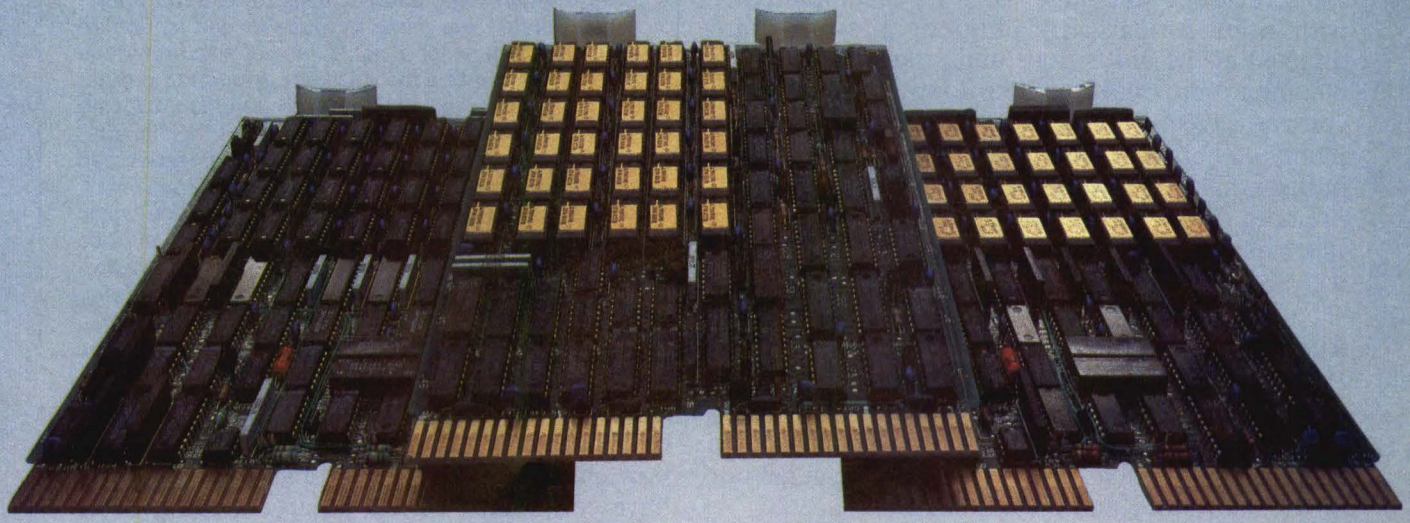
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CIRCLE 128

out a winner. This ready availability of low priced media provided the impetus necessary to reverse Seagate's course. Abruptly curtailing its evaluation of Sony's unit, Seagate Technology (Scotts Valley, Calif) decided to join the 3¼" camp. Their licensing agreement with Tabor adds credibility to the 3¼" soft cover design by putting an established manufacturer in the ranks. Key to keeping assembly costs low is snap-fit plastic parts that are lightweight and easily assembled. Since manufacturers are already turning out 8" and 5¼" media by the ton, they should be able to adapt to and churn out the 3¼" media without batting an eye.

Going it alone, IBM seems to be marching to a different drummer. Its entry, long rumored to have a 3.9" form factor, turns out to measure 4". Dubbed model 341, the single-sided unit stores 358k bytes unformatted, 250k bytes formatted, and breaks no records.

Recording on 46 tracks/surface, the drive puts up to 6332 bits on the inner track (0), and writes up to 9552 bits on track 45 using FM techniques. Spindle drive motor speed is controlled by the location of the track to which the R/W head is positioned. This variation in the diskette's rotational speed (in the range between 262 and 415 rpm) maintains bit density at a constant 6865 bpi as the head moves from inner to outer track. Track to track access occurs in 40 ms. Data transfer rate is 333k bytes/s.

This 4" drive, injected into the already confused market, has been greeted less than enthusiastically. Among its attributed disadvantages are its lack of capacity commensurate to its size, the bulk of its 2-piece plastic cartridge, and its incompatibility with prior formats. In addition, grievances are directed at the unit's nonstandard access time and incompatibility with the minifloppy interface. The consensus seems to be that if the drive had appeared in any IBM product, then it would have made sense in the industry. However, coming as it did as an announced OEM product, it only raises questions as to IBM's possible objectives in offering yet another distraction in an already fragmented environment.

A monumental change

Whether or not sub-5" drives will stave off the death throes of flexible media remains to be seen. The answer greatly depends on how rapidly other technologies, such as optical recording, can get out of the laboratory and into the marketplace.

One technology that promises to extend the floppy's lifeline still further is that of perpendicular or vertical magnetic recording. Holding the potential to step up the pace of capacity increases, vertical recording could bring a quantum leap in capacity. Although this technology also relates to hard disks, the first products to emerge will use flexible media.

Packaging sub-5" media

The hard-jacketed design, used first by Sony, is claimed to increase reliability by reducing friction between the moving disk and its stationary envelope and by preventing other accidental damage to the medium. The envelope contains a spring loaded aperture cover that automatically opens when the disk is inserted in the drive and automatically closes when removed. Proponents claim that this technique will minimize environmental contamination of the recording surface caused by dust, fingerprints, and dirt.

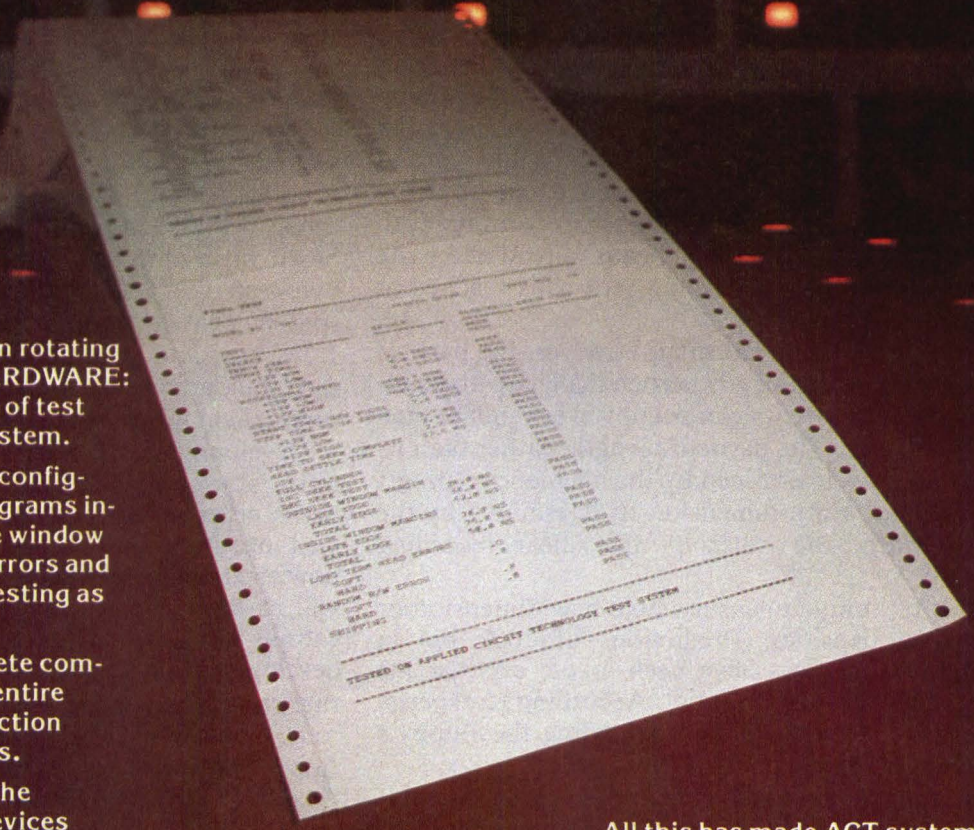
Advocates of the hard shell cartridge claim that this approach offers media protection advantages over competing proposals. The hard shell cartridge protects the recording surface far better than does the traditional soft diskette envelope or the 2-piece hard plastic covering on the 4" diskette. In addition, because the automatic shutter remains closed over the head access window until the cartridge is inserted in the drive, and closes when it is removed, the diskette surface is always protected.

Although opponents argue that the flexible jacket cannot provide the media protection necessary for the smaller floppies, Tabor President Mike Hanley refutes that claim. Even a hard package will be invaded by dust and dirt unless it is hermetically sealed, and according to Hanley, it supplies a much less effective wiping action than the soft jacket. He also claims that hard shells are too expensive and that potential manufacturers must endure expensive retooling in order to produce them. Therefore, soft-jacketed media will become available while hard-shell manufacturers still try to work out the bugs. In addition, the soft-jacketed forms should also cost substantially less than the hard, since they undersell the hard by 40%.

IBM'S medium, called a DemiDiskette, consists of three parts—a protective pouch, a rigid outer case called the cartridge, and the diskette within the cartridge. Serving the same purpose as the cardboard protective sleeve for flexible media, the protective pouch is formed of a material rigid enough to protect the diskette yet flexible enough not to crack. Slipping inside this pouch, the cartridge encloses the diskette, leaving free only the R/W head and pressure pad access slots and the spindle clamping mechanism. A pressure cleaning pad incorporated in the cartridge is pushed against the diskette's recording surface when the diskette is clamped into the drive; this provides the continuous cleaning action that Dysan/Tabor claim other hard-jacketed diskettes do not provide.

Vertical recording hurdles the density limitations of traditional longitudinal recording techniques now challenging drive manufacturers. Researchers have continually raised linear recording densities over the past 30 years by decreasing the distance over which a single flux change occurs. However, two inherent magnetic phenomena limit further increases. Demagnetization—the misalignment of magnetized regions caused by the repulsion of like poles—limits reading density to 30k fcpi. Peak shift—displacement of apparent transitions by overlapping pulses—limits densities to 28k fcpi.

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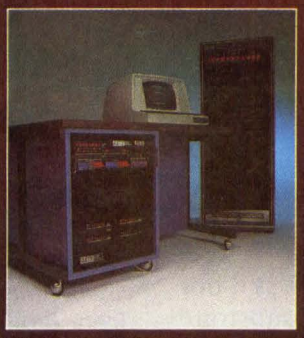
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CIRCLE 129

These limits can be stretched by using better magnetic materials in the media in conjunction with thin-film heads. However, no significant amount of change is possible.

Vertical recording may provide the impetus to extend flexible media's lifeline well into its second decade.

Perpendicular recording minimizes these phenomena's effects by turning the magnetized zones 90°. This overcomes the limitations imposed by the well-understood principle that a permanent magnet must be several times longer than it is thick. The thickness of the substrate's magnetic coating determines one dimension of the thickness or width of the magnetic particles in conventional longitudinal recording. The other dimension of width is determined by the recording tracks' width. This waistline constrains attempts to increase density by decreasing the particle's length. While certain density gains have been achieved using thin-film plating and sputtering techniques in forming both the media and the thin-film heads to read and write on it, a point of diminishing returns is reached at about 15k domains/in.

If, as in vertical recording, however, the particle is placed with its length perpendicular to the substrate, more particles can occupy every square inch of the surface. The particle's length, rather than its width, is now determined by the magnetic coating's depth. One width dimension is determined by the track width, the other by the linear recording density.

This technique opens a whole new dimension of recording densities. Predictions of 100k bpi in commercial devices have been made; experiments suggest a 440k-bpi potential. According to experts, here lies the secret behind extending the floppy's lifeline.

Another bonus results from the vertical orientation of the magnetized particles. In longitudinal recording, a signal waveform created in the R/W head peaks at the transition between domains. In vertical recording, the electrical waveform representing a data bit changes sign at the transition between domains. Thus, a bit is represented by a polarity reversal rather than by a peak in the signal waveform. This makes domain size independent of bit density and produces sharper flux transitions than in longitudinal recording.

Disks suitable for vertical recording are still not generally available. Consisting of a substrate coated with a thick film of cobalt chromium, they are manufactured using vacuum sputtering techniques. Developed for semiconductor industry use, the techniques need to be modified before they can produce sufficient reproducible quantities to meet media needs.

To achieve maximium potential from the media will require special R/W heads. Although conventional ferrite R/W heads can reach 15k bpi, thin-film, single-pole heads can jump densities upward from 30k fcpi.

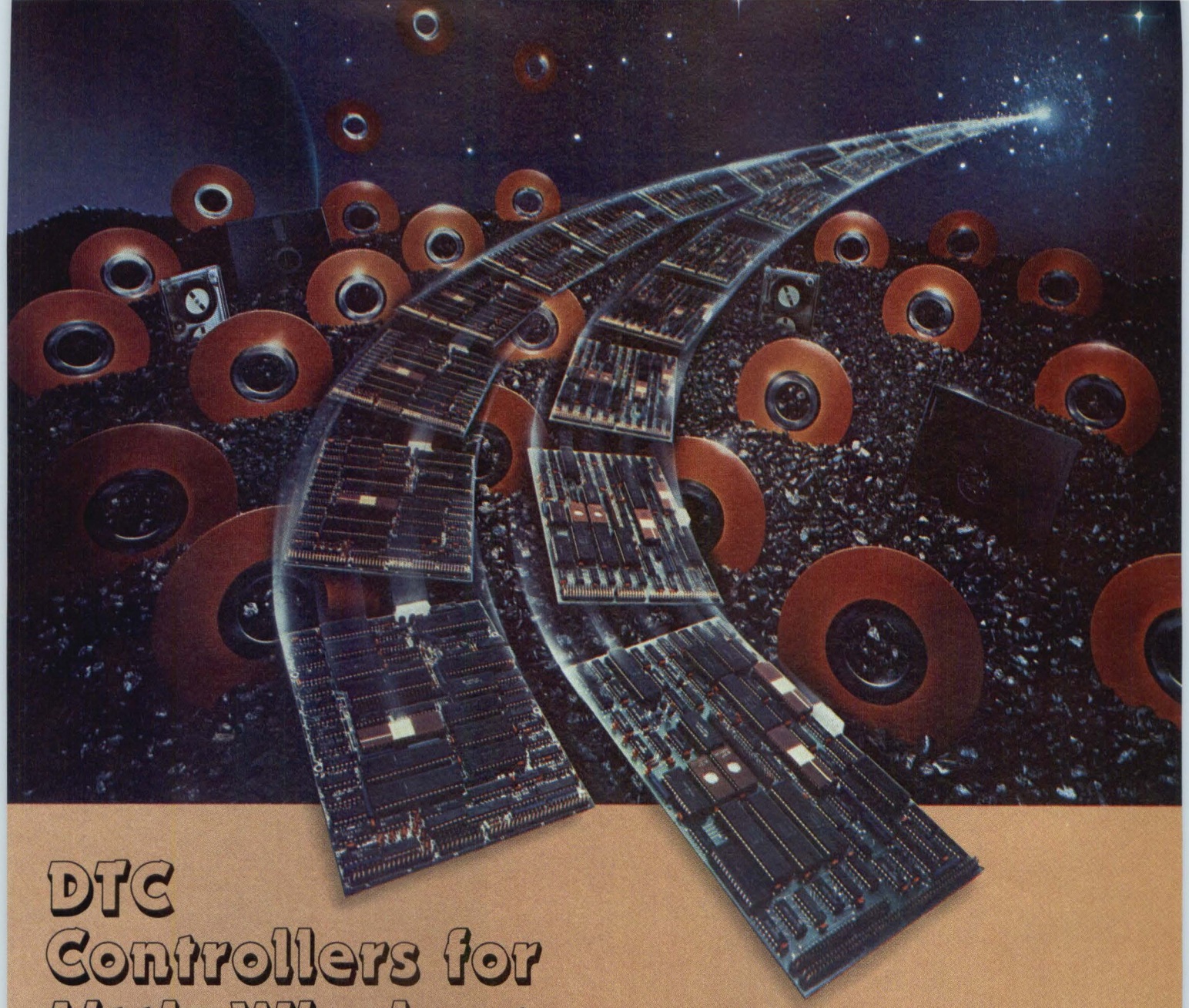
Since Japanese researcher Professor Shun-ichi Iwasaki of Tohoku University is called the father of vertical recording, and the bulk of the basic research has been done in Japan, it is appropriate that one of the first prototypes of a vertical recording disk drive was revealed by Toshiba Electric Co (Tokyo, Japan). Promising 3.5M-byte capacity when it becomes commercially available in about two years, the 3½" drive records on a flexible disk enclosed in a hard plastic shell. The drive uses a ring head with a 0.4-μin gap to write on the diskettes' 0.5-μin thick cobalt chromium film coating.

Closer to reality is a 5¼" drive being demonstrated in prototype form by Vertimag Corp (Minneapolis, Minn). Writing 36k bpi on the inner tracks using MFM recording techniques, this unit is based on a standard Shugart drive. It packs 5M bytes on the 5¼" surface of cobalt chromium-sputter coated flexible media, transfers data at 1.7M bps, and is compatible with the SA400 interface standard. Price is set at approximately $500 in original equipment manufacturer quantities.

Development of vertical recording techniques into viable commercial devices may provide the impetus necessary to extend flexible media's lifeline well into its second decade. The scaled-down units now emerging, if indeed a standard can be achieved, will certainly open up a greater variety of applications for disk drives of all kinds. Additional developments in thin-film heads and media may further stretch capacities. In any case, it seems logical to assume that instead of fading into obscurity, the floppy may soon become ubiquitous.

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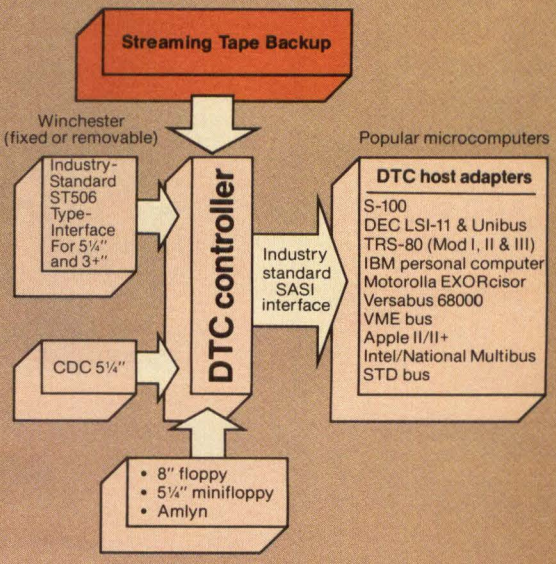
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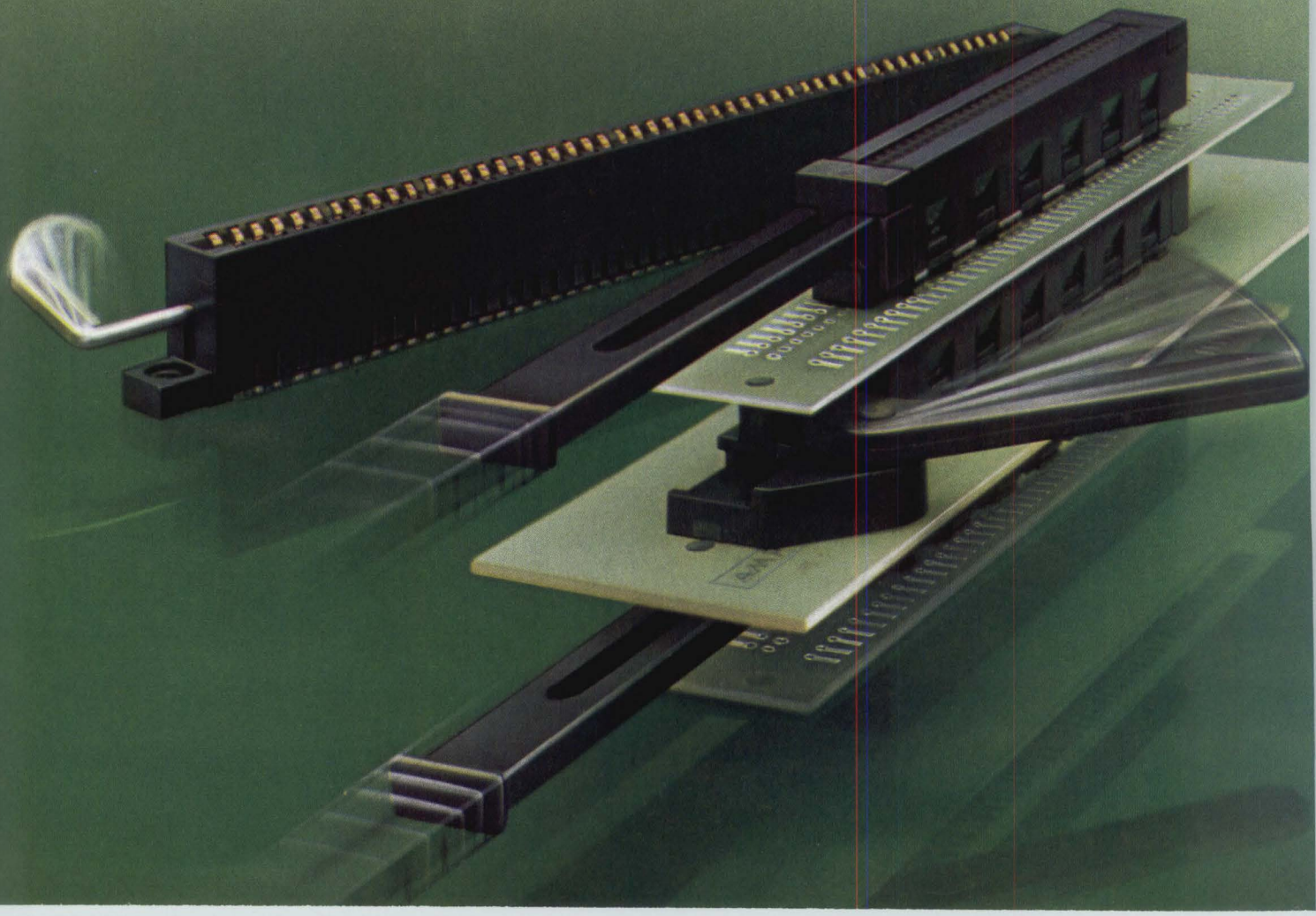
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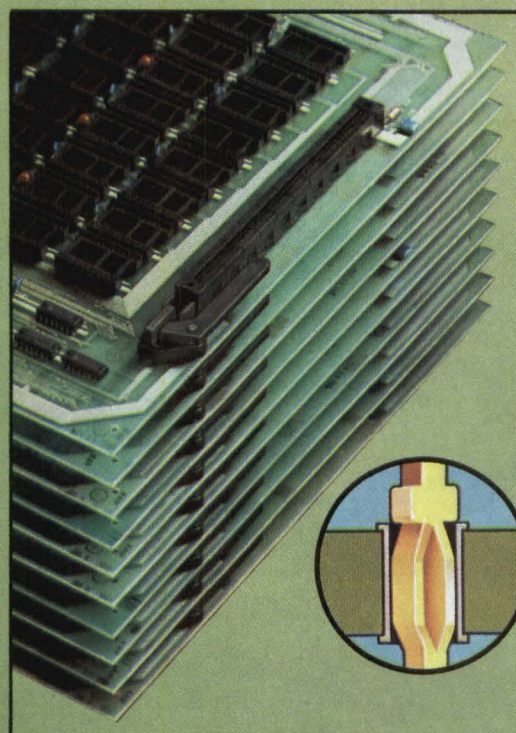
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CIRCLE 131



BUILT FOR SPEED: QUARTER-INCH STREAMING TAPE DRIVES

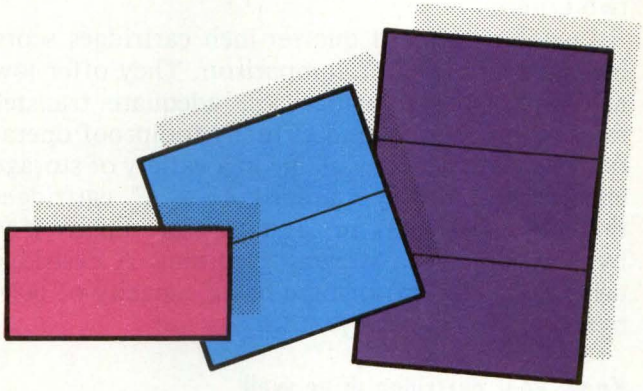
By optimizing disk file formats and buffer memory schemes, system integrators can fine tune their machines for use with streaming cartridge drives. Beware, however; the throughput race does not always go to the swiftest.

by Louis C. Domshy

In the explosive small- and medium-sized computer system market, streaming quarter-inch cartridge tape has proven to be a cost-effective solution to the problem of Winchester backup. While the quarter-inch streamer cartridge is ideal as a removable backup medium, the key to its successful system integration is a full understanding of its abilities, its limitations, and its unique characteristics. Also essential to successful integration is a thorough understanding of the application requirements that backup media must meet.

Generally, three different criteria apply to the selection of cost-effective backup media for a given application. One, of course, is the cost of the hardware. This cost is normally expressed on a per megabyte of removable storage basis. Cost can be averaged over total capacity when storage is both fixed and removable. Comparative hardware costs (Table 1), a major concern for system suppliers, are not necessarily the most important consideration for users.

Louis C. Domshy is manager of product management at Archive Corp, 3540 Cadillac Ave, Costa Mesa, CA 92626, where he has been involved in magnetic tape controller design and development. Mr Domshy is presently responsible for the Sidewinder and Scorpion product lines. He holds a BSEE from the University of Saskatchewan and an MSEE from the University of California, Irvine.



Equally important to users is a second criterion: storage cost. Storage costs include the media and are usually based on a per-megabyte figure. Added to this baseline figure, however, are storage costs associated with the time it takes both the operator and the computer to transfer data to and from the backup media. Comparative backup media costs are shown in Table 2. The relative importance of these two criteria varies according to the application. For instance, if large volumes of data are destined for archival storage, media costs are a principal concern. If backup and restore operations occur during periods of heavy system usage, then transfer times take precedence. If an operator is distracted from other, more critical tasks or is just not available, then the number and simplicity of media insertions may actually be the deciding factor.

Closely associated with hardware and storage costs is the third selection criterion: the physical and functional requirements of the application.

TABLE 1

Backup Equipment Costs (1982)

Backup device	Formatted capacity (megabytes)	Device cost (quantity 500)
8″ floppy disk drive	.8 to 1.3	$300 to $400
Quarter-inch streaming cartridge tape drive	20 to 45	$550/650 to $950/1100
Quarter-inch start/stop cartridge tape drive	8.6 to 15	$1100
Fixed/removable disk drive (5¼″, 8″)	5 to 10 (removable)	$1500 to $2200
Removable cartridge drive (5¼″, 8″)	5 to 10	$1200 to $1800
Half-inch tape, start/stop drive, 75 ips, 6250 bpi (2400′)	15 to 160	$3000 to $5000
Half-inch tape, streaming drive, 100 ips, 1600 bpi (2400′)	15 to 42	$2200 to $2800

Included here are such factors as available panel space, equipment cosmetics, operator convenience, storage space required by archival records, and the ease with which the media can be handled. In the real world, any one of these requirements may override the economic considerations for the first two criteria.

Luckily, standard quarter-inch cartridges score high at every level of comparison. They offer low media costs, high capacities, adequate transfer rates, compact size, and virtually foolproof operation. And, they are available in a variety of storage capacities. Industry-standard 4″ x 6″ cartridges that hold 450′ (137 m) of tape store up to 45M bytes of data in a streaming format. A cartridge using 600′ (183 m) of tape has a capacity of 60M bytes.

Know your cartridge drive well

A prerequisite for successfully integrating a streaming tape drive into a system is the full understanding of its characteristics, abilities, and liabilities. Some of these include data handling specifications such as data density, recording form and code, as well as start/stop timing. Sensitivity to shock and vibration and other physical and environmental phenomena merit investigation as do power and interface requirements. Some typical Archive Corp streamer specifications appear in the Panel.

As the name implies, streaming tape drives are designed to function in a nonstop mode. The streaming tape format allows 97% tape utilization by replacing the customary inter-record gap with a short resynchronization field. Data are blocked into 512-byte segments with sync bytes, address marks, and check characters being added before the entire block is written to tape. On subsequent read operations, all extraneous characters are removed, leaving only the 512-byte data field to be transferred to the host.

No attempt is made to start or stop the tape within the inter-record gap or resynchronization area. However, if the data transfer rate to a streaming tape is inadequate to maintain streaming, the device is forced to stop and wait for the host to catch up with data transfers. Stopping invokes a time-consuming algorithm that first stops, then reverses the tape. The tape is repositioned ahead of the last processed block. Once this is accomplished, the tape is started in the original direction and accelerated to read/write speed. Data transfer then resumes. Even though this operation is performed automatically and is transparent to the host, it is time consuming (over 1 s) and should be avoided whenever possible.

Defining functional requirements

An essential task in integrating a streaming tape drive into an original equipment manufacturer's system is determination of the functions that the drive must perform. Because it will undoubtedly be used as the backup medium for a Winchester disk, the issue is what type of backup operation will be supported. This distinction is important because the type of disk operation being performed greatly influences the disk transfer rate.

Most common as a type of backup operation is the image copy. Here, an entire disk's contents are transferred to tape. Since the entire data set is being transferred, no effort is made to segment the date into logical files. Other backup operations, in which only selected files or data fields are transferred, are possible. Selection of data to be backed up will vary with each system and can be determined by software or by operator intervention. Software control can be based on the date of the last file update or other priority schemes.

Streaming tape use need not be limited to Winchester disk backup, however. With the proper system architecture, a streaming tape drive can

Intelligent streaming cartridge specifications

DATA HANDLING

Head type	Read after write with separate erase bar
Flux density	10,000 flux reversals per inch
Recording form	NRZI, bit serial, serpentine
Recording code	Run-length limited (0, 2)
Data density	8000 data bpi
Tape speed	90 ips or 30 ips
Start/stop time	
90 ips	300 ms max
30 ips	100 ms max
Reliability	
MTBF	Greater than 3500 h of use
MTTR	Less than 0.5 h
Error rates	
Soft read errors	Not more than 1 in 10^8
Hard read errors	Not more than 1 in 10^{10}

SHOCK

Equipment Operational	2.5 g max, ½ sine wave, 11-ms duration on any axis
Equipment Nonoperational	25 g max, ½ sine wave, 11-ms duration on any axis

VIBRATION

Equipment Operational	0.005" max peak to peak displacement, 0 to 63 Hz; 1 g max acceleration, 63 to 500 Hz
Equipment Nonoperational	0.1" max peak to peak displacement, 0 to 17 Hz; 1.5 g max acceleration, 17 to 500 Hz

POWER REQUIREMENTS

DC voltages	24 Vdc	5 Vdc
Tolerance	±10%	±5%
Max peak to peak ripple	500 mV	100 mV
Current		
Standby	0.2 amp nominal	3.5 amps max
Operational	0.8 amp nominal	3.5 amps max
Tape start surge	2.5 amps max 1.7 amps max (up to 300 ms; may be longer for defective cartridge)	
Power-on Sequence	24 Vdc before 5 Vdc (or use reset)	
Voltage rise time	100 ms max	50 ms max
Power dissipation	35 W typical 60 W max	

ENVIRONMENTAL REQUIREMENTS

Temperature	Operational 5 to 45 °C	Nonoperational −30 to 60 °C
Relative humidity (noncondensing)	20% to 80%	0 to 99%
Altitude	−200 to 15,000'	−200 to 50,000'

PREVENTIVE MAINTENANCE

Head cleaning should be done after the first 2 h of tape movement of a new cartridge and every 8 h of subsequent tape movement, using a lintless cotton swab coated with Isopropyl Alcohol or IBM tape cleaner.

PHYSICAL DIMENSIONS

Depth	14 ± .01" (355.6 ± .25 mm)
Width	8.55 ± .01" (217.2 ± .25 mm)
Height	4.5 + 0, − .2" (114.3 + 0, − .51 mm)
Weight	4 ± .2 lb (1.81 ± .09 kg)

TABLE 2

Backup Media Costs (1982)

Device	Formatted capacity (megabytes)	Media number for 20/45 megabytes	Total media cost for 20/45 megabytes	Recording time (minutes) for 20/45 megabytes	Operator involvement
8" floppy disk drive	.8 to 1.3	16/32	$80/160	34/68	Multiple media insertions
Quarter-inch streaming cartridge tape drive	20 to 45	1/1	$30/30	4/9 (90 ips) 12 (30 ips)	One media insertion
Quarter-inch start/stop cartridge tape drive	8.6 to 15	3/6	$90/180	60/120 (30 ips)	Multiple media insertions
Fixed/removable disk drive (5¼", 8")	5 to 10 (removable)	2/4	$200/400	4/8	Multiple media insertions
Removable cartridge drive (5¼", 8")	5 to 10	2/4	$200/400	4/8	Multiple media insertions
Half-inch start/stop drive, 75 ips, 6250 bpi (2400')	15 to 160	1/1	$10/10	6/12	One media insertion
Half-inch streaming drive, 100 ips, 1600 bpi (2400')	15 to 42	2/3	$20/30	11/18	Multiple media insertions

function as a true removable medium. Now, traditional functions, such as software distribution or program swapping, as well as program and system loading, can be served by streaming tape cartridges.

In addition, streaming cartridge drives must communicate efficiently with the host computer and, directly or indirectly, with one or more disk units. Design considerations therefore include not only streaming cartridge characteristics but also the performance levels that the host and disk drives are capable of attaining.

Of major importance, for example, are the disk system's absolute and relative capacities. Because, of course, there is no limit to the amount of detached, archival streaming tape storage, the design question centers on the appropriate amount of attached tape capacity. This capacity is highly application dependent. In multi-user environments, for example, designers may decide to take advantage of the per-megabyte savings of a high capacity disk drive that all users share. Therefore, in this case, it is logical to back up the disk with a high capacity cartridge drive so that the complete contents of the disk can be unloaded without media change. In many instances, however, it may be important for users to physically retain possession of their data or application programs. One or more smaller capacity cartridge drives makes this possible.

Another distributed data scenario involves the partitioned Winchester disk. Here, a number of logical units are defined as an area of disk space (cylinders and tracks). System software recognizes and treats each logical unit as one device. As an example, CP/M operating systems often define the capacity of a disk unit as less than 10M bytes. To meet this requirement, a 40M-byte Winchester disk can be divided into four or more logical units, each appearing as a unique disk to the operating system.

In a multi-user environment, logical partitioning of a relatively large Winchester disk provides efficient use of both disk and tape storage. An obvious advantage of this scheme is the ability to assign logical units to system users on an "as needed" basis. When users wish to go online, they merely load their data base from streaming cartridge tape into the assigned logical disk unit. Once loaded, the programs can be transferred between logical disk units via standard operating system functions such as peripheral interchange program (PIP) or COPY.

When a user concludes a work session, the updated data base is dumped to a streaming cartridge tape. The data base is now safely stored on tape, and the logical disk unit is available to other users. Logical disk unit schemes also allow tape cartridges to function as primary storage. As a result, the size of the disk required is reduced because only the number of users who are online at any one time need be supported. Further, logical disk capacity can be selected to match the streaming cartridge drive capacity. Logical disk units can also be used as scratchpad areas to temporarily store widely segmented data prior to their transfer to streaming tape.

Also playing an important role in successful streaming tape performance is the data structure supported by the host system. Both the average file size and disk storage space allocation greatly influence the number of disk seek operations performed during file mode transfers. Because frequent access to the disk directory results in file mode operation, the location and handling of the disk directory is of prime importance.

Most other system considerations relate, directly or indirectly, to backup and restore transfer rates. Speed is critically important when transfers occur in an interactive environment or involve host resources normally committed to other tasks. Also,

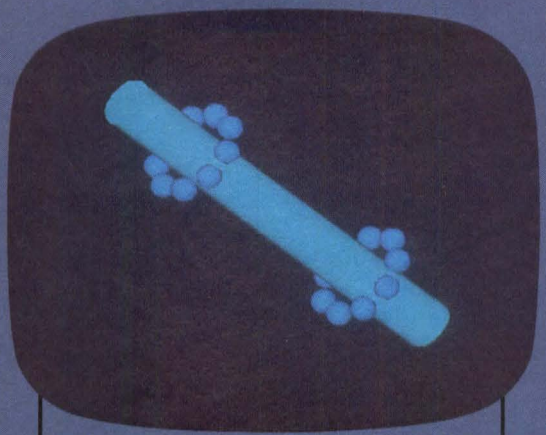
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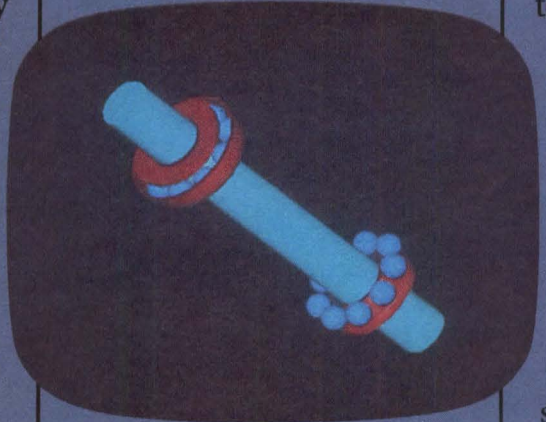
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CIRCLE 132

the transfers may not have to be as fast or as efficient when their primary purpose is end of the day archival storage or start of the day program loading.

Types of transfer determine architecture

In the majority of systems, there are three separate transfer rates: host, streaming cartridge drive, and Winchester disk. Because the burst or maximum transfer rate in all three cases is insignificant, only operation dependent rates—often a fraction of the maximum rate—should be considered.

In general, the host computer will be the fastest element in the system as long as host resources are available for the transfers and no interruptions occur. This is assuming, of course, that a direct memory access (DMA) channel can be used at least for the host–disk transfers and ideally for transfers to and from the tape device as well. The highest rate would be a burst DMA transfer that preempts all other host activities. More realistically, the transfers would be in a cycle-stealing mode and subject to interruption by higher priority tasks.

Moreover, the host can limit the overall transfer rate by restricting the size of the average transmission to or from the streaming tape drive. Transmission size has a nonlinear effect on the average rate at which a streaming cartridge drive can write or read data. If the host memory is the principal buffer between disk and tape, the amount of memory allocated to the task will, in many instances, put a ceiling on the effective rate of the streaming tape transfers.

The nominal transfer rate of a streaming tape device is the tape speed multiplied by the linear data density. At 90 inches per second (ips) and a recording density of 1000 bytes/in, the theoretical write/read rate is 87,300 bytes/s. With the speed reduced to 30 ips, the rate is 29,100 bytes/s.

These figures are based on continuous tape motion and 97% tape utilization. If the system is unable to supply or to receive data for more than a few milliseconds (typically less than 6 ms for a 90-ips drive, 17 ms for a 30-ips drive) drive buffers will underrun, and the tape will stop. Curiously, under these conditions, the high speed of a 90-ips drive becomes a liability. It takes longer to stop and accelerate the higher speed tape drive. Moreover, streaming tape, with its short resynchronization field, is certain to overshoot its restart point, requiring another acceleration and deceleration cycle as the tape backs up.

Buffer underruns become far less costly, and 90-ips drives become more important as the amount of data transferred between interruptions

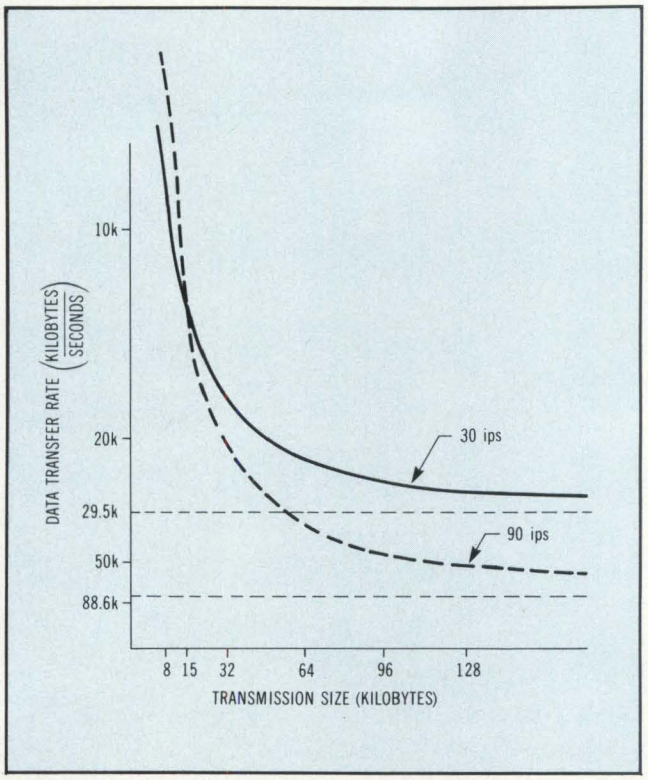


Fig 1 When streaming must be interrupted, large transmission blocks are essential for efficient 90-ips tape speed operation (dashed line). If data rates to the streaming cartridge fall below those required for continuous operation, the overhead associated with tape stopping and restarting could become prohibitive. In such cases, a slower, 30-ips speed streamer (solid line) exhibits higher throughput.

exceeds 64K bytes. Fig 1 plots transmitted data amounts against the average transfer rate. The curves show that large blocks of data are required for efficient operation. Even when the data are adequate for streaming, system constraints on throughput may limit tape operation to 30 ips. Also, due to different data transfer rates and tape repositioning times, a 30-ips drive may outpace a 90-ips drive for small and medium transmissions.

Disk transfers

Average disk transfer rates are normally several times that of even a 90-ips streaming cartridge drive. Unfortunately, the way data are organized on a disk makes it extremely difficult to smooth data flow and achieve transfer rates equal to the demands of continuous streaming. This is particularly true when data are being read from disk. The information, often scattered among different tracks, requires frequent head repositioning in order to be read. Latency (rotational) delays can also cause a problem by presenting the wrong part of the disk to the read head at a given time.

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CIRCLE 133



Most Winchester controller/formatters support multisector accesses—a first requirement for adequate-sized transmissions. Such accesses are of little value, however, if the tape is unable to take the data as contiguous sectors are read. If buffering is inadequate, the system has to wait until the disk makes a complete revolution before the next set of sectors can be read. At 3600 revolutions per minute this delay approaches 17 ms. During this period of time, a 90-ips tape drive can write three 512-byte blocks. Additional buffering is therefore necessary to maintain streaming throughput.

Sector interleaving is one method of reducing the required buffer's size. By assigning sequential addresses to alternate sectors (2 to 1 interleaving) or every third sector (3 to 1 interleaving) the transfer rate for multisector accesses is reduced by approximately one-half or two-thirds. Now, the disk transfer rate approaches that of a continuously streaming cartridge.

Streaming must also be sustained during the time it takes to move the disk heads from one track to the next. Here, the designer faces a tradeoff between buffer storage and the higher cost of a faster head-positioning actuator.

Head positioning between widely separated tracks can take more time than the amount of buffering can accommodate. The task, therefore, is to maximize the amount of data that can be transmitted between interruptions. One approach is to select multisurface and multihead disk drives with high cylinder capacities. Another alternative is to organize data on the disk specifically for streaming transfers. If this is impossible, a set of contiguous tracks or cylinders could be reserved as a staging area for data. File management functions performed during backup can be accomplished as the data are copied into this reserved space.

An effective way to evaluate all these storage alternatives is to start with a typical Winchester disk. In this hypothetical system, assume the following operational parameters

Rotational latency	
Maximum	20 ms
Average	10 ms
Access time	
Track to track	15 ms
Average	65 ms
Maximum	100 ms
Formatted capacity	
Sector	256 bytes
Track	8k bytes
Cylinder	64k bytes
Sector transfer time	0.625 ms

When one cylinder of data is transferred with the disk head ideally positioned over the required data, the burst transfer rate is given by

$$\text{Burst transfer rate} = \frac{\text{Transfer size}}{T_{transfer}}$$

where

$T_{transfer}$ is the time to transfer the data and is given by

$$T_{transfer} = \left(\frac{\text{Transfer size}}{\text{Sector size}}\right)\left(\frac{\text{Sector transfer}}{\text{TIME}}\right)\left(\frac{\text{Interleave}}{\text{factor}}\right)$$

$$= \frac{64{,}000}{256}\,(.625 \times 10^{-3})\,(1)$$

$$= 0.15625 \text{ s}$$

Therefore

$$\text{Burst transfer rate} = \frac{64{,}000}{.15625} = 409.6\text{k bytes/s}$$

But, beware. This figure can be misleading. In most real-world operations, the disk drive must reposition the head during the read operation. This involves large time delays that result in much lower transfer rates. In an image copy mode of operation, for example, a complete cylinder of data is transferred and the head assembly is moved to the adjacent cylinder. In addition to a stepping delay, this typically adds one rotational delay during which no data are transferred. Data transfer rate calculations for this case, assuming a 10M-byte transfer, are given by

$$\text{Effective transfer rate} = \frac{\text{Transfer size}}{T_{position} + T_{transfer}}$$

where

$T_{position}$ = Total time to position the disk head assembly

$$= \frac{\text{Transfer size}}{\text{Cylinder size}}\,(\text{Maximum latency time})$$

$$= \frac{10{,}000{,}000}{64{,}000}\,(20 \times 10^{-3}) = 3.13 \text{ s}$$

and

$$T_{transfer} = \frac{\text{Transfer size}}{\text{Sector size}}\left(\frac{\text{Sector transfer}}{\text{size}}\right)\left(\frac{\text{Interleave}}{\text{factor}}\right)$$

$$= \frac{10{,}000{,}000}{256}\,(.625 \times 10^{-3})\,(1)$$

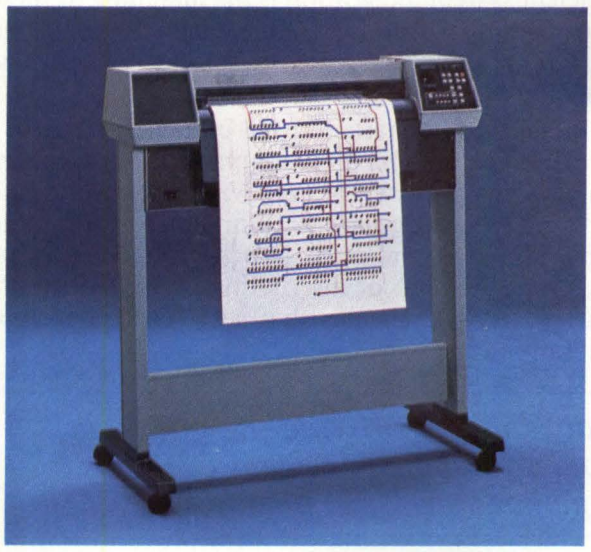
$$= 24.41 \text{ s}$$

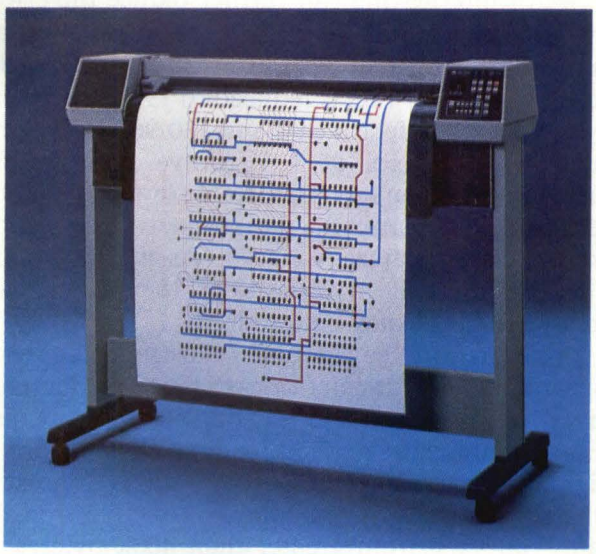
Therefore

$$\text{Effective transfer rate} = \frac{10{,}000{,}000}{3.13 + 24.41} = \frac{10{,}000{,}000}{27.54}$$

$$= 363.1\text{k bytes/s}$$

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CIRCLE 134

Sector interleaving can further reduce the effective transfer rate of the Winchester disk. With an image copy mode of operation, for example, the effective transfer rate is reduced to 192.49k bytes/s by an interleave factor of 2 and 130.96k bytes/s by an interleave factor of 3. Effective data transfer rates become even less predictable in the file mode of operation because the data to be transferred do not reside on adjacent tracks. As a result, considerably more head repositions to virtually any area of the disk may be required.

Transfer rate calculations illustrate the wide variation in disk transfer rates that are encountered in various operating modes. In general, most disk transfers are characterized by data bursts. Here, a high transfer rate is separated by periods of no data whatsoever. In such situations, effective transfer rates can vary from greater than 400k bytes/s to less than 50k bytes/s, separated by periods (as long as 120 ms) where there are no data at all.

Buffers key to continuous streaming

To maintain streaming tape operation, two basic conditions must be satisfied. The first requirement is an effective disk transfer rate that is greater than the average tape transfer rate. If this condition is not met, the tape will overrun disk data transfers. Solutions could be a slower streaming tape drive or the staging of disk data on spare disk cylinders prior to tape transfer. The second requirement for streaming is an adequate-sized buffer to maintain tape data transfers during periods of disk latency.

Obviously, a wide range of variables affect the data transfer characteristics of streaming cartridge drives and Winchester disks. The key to their efficient system integration is the matching of these two dissimilar, and variable, data rates. Data buffers provide the glue that holds the diverse system elements together.

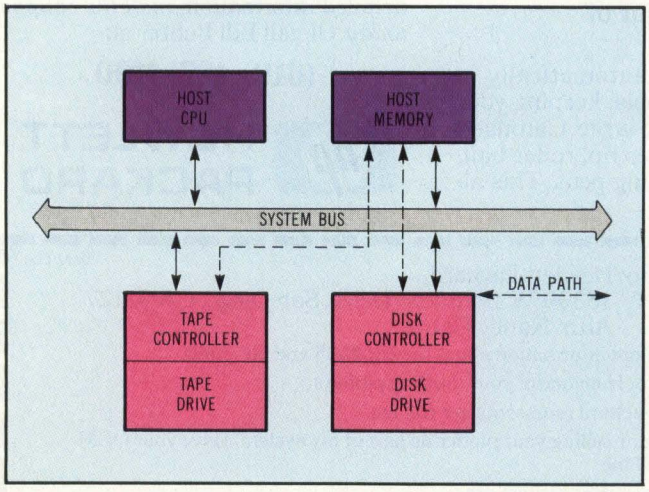


Fig 2 In a data buffer architecture using host memory, all communication takes place over the host bus. This may lead to serious contention problems, slowing overall throughput. Worse still, valuable host memory is usurped by buffer space.

Input/output characteristics of a buffer used in a streaming tape must encompass the maximum burst transfer rate of the Winchester disk and streaming cartridge drives. Simultaneous disk and tape data transfers must also be supported. First in, first out, ring, or alternating multiple memory buffers are all schemes that serve streaming tape operation.

Data buffers provide the glue that holds the diverse system elements together.

Data buffer size is dictated by the maximum disk latency that must be supported in a streaming cartridge mode. Designers must remember that disk latency varies with the type of operations performed. Since the 90-ips cartridge drive transfers 512 bytes of data in approximately 6 ms, a general buffer design guideline is to provide a minimum of 1K bytes of buffer storage for each 10 ms of disk latency. Overhead timing for data buffer management may add to this requirement.

Actual data buffer location varies depending on system architecture. One alternative uses host memory. Fig 2 shows the resulting architecture and the data paths. An advantage of this approach is that it uses an existing memory resource; a disadvantage is that a large portion of host memory may be required for buffer space, limiting the tape operation to standalone functions or to inefficient online streaming. This approach can also result in increased bus contention problems because each data byte is transferred twice, once into host memory and once out of host memory.

Another approach, placing the data buffers in the tape controller, is shown in Fig 3. This approach eliminates the host memory as a restriction, offering an effective solution if the system allows device to device data transfers as in the Small Computer Systems Interface (Shugart Associates Standard Interface) system architectures. In systems that do not allow device to device data transfers, this approach eliminates the host memory as a restriction but may impose bus contention restrictions.

A third alternative to the buffer space dilemma combines a disk/tape controller with a shared data buffer (Fig 4). This alternative has the advantage of offloading reponsibility for the disk to tape transfer to the controller, freeing the host central processing unit (CPU) and system bus until the

operation is complete. The same data buffer can also be used for disk to host or for tape to host data transfer.

There are many problems inherent in disk backup in small- and medium-sized computer systems. Clearly, the quarter-inch streaming tape cartridge can make an important contribution. When thoughtfully integrated into a system using Winchester disks, streaming cartridge drives provide users with a functional and flexible tool suitable for backup, archival storage, program and data transportation, and personal data security.

Since streaming drive performance is intimately tied to disk formats and operations, optimizing disk file structures for streaming data transfers is wise. Because its low cost, low maintenance, high reliability, and ease of use make its optimization well worthwhile, the quarter-inch streaming cartridge drive is likely to remain at the forefront of the mass storage backup market for some time to come.

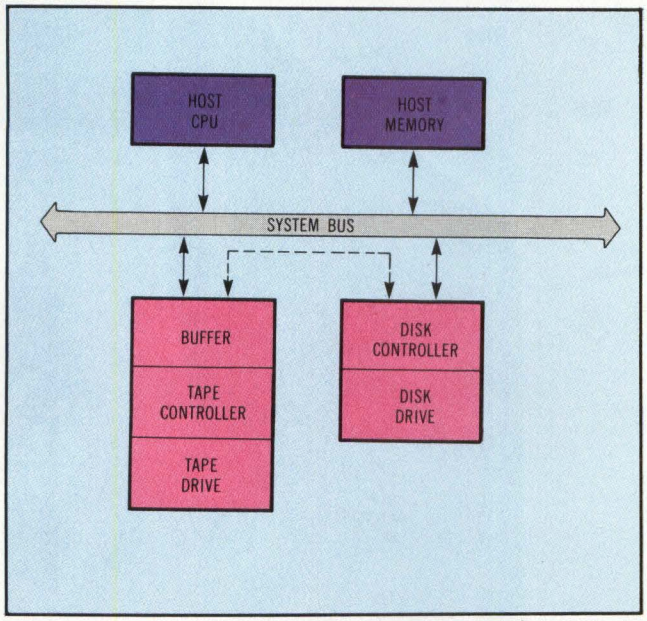


Fig 3 A buffer architecture that places data buffers in the tape controller eliminates problems involved in host memory buffer schemes. Data transfers still use the host bus, however, and contention problems remain.

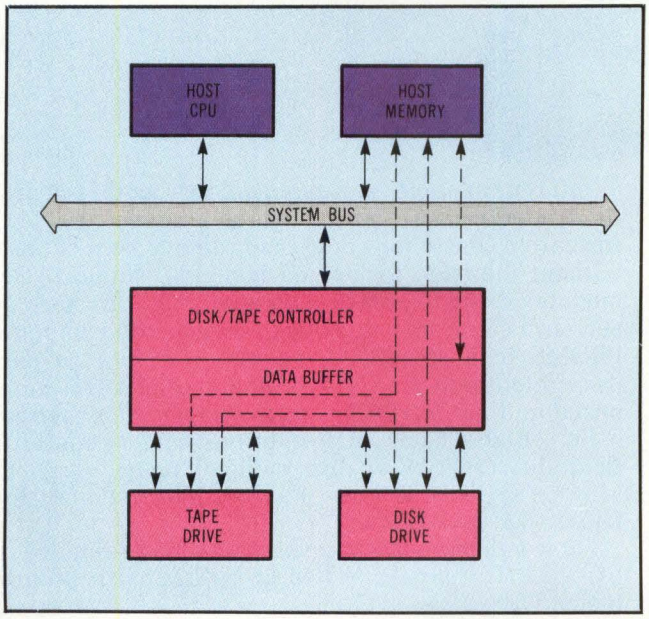


Fig 4 A combined intelligent disk/tape controller includes data buffers within its confines. Now, the host bus is only used for issuing commands to the controller. Thus, the host retains access to its program and memory before, during, and after all data transfers.

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CIRCLE 136



RETHINKING WINCHESTER BACKUP

Disk backup options are evolving almost as fast as the Winchester technology they strive to support. This overview of secondary storage highlights two of the most recent schemes.

by Larry D. Hemmerich

Since Winchester disks burst upon the scene, it seems that system manufacturers have continually wrestled with the backup issue. The search for the perfect solution is ongoing. Moreover, the number of differing opinions as to just what backup really is makes the decision even more confusing. At one extreme are those who say backup is not necessary. At the other end of the spectrum are those who advocate mandatory redundancy of disk systems.

In its most simple definition, backup is disaster protection: methods of providing or reconstructing data in the event of a head crash, system failure, or any other event that would prevent recovery of data previously written on a Winchester disk. In the real world, however, that classical definition becomes expanded into a function that provides more than just disaster protection. System designers find that they need archival storage in lieu of keeping everything on the Winchester, and input/output either for software distribution, program loading, or general transportability of the data. The backup device—if properly designed—becomes more than just disaster protection. Its selection should match the basic requirements of the system. The best definition of a backup device is that of a partner to the Winchester that provides functions that the basic Winchester cannot, such as interchangeable archiving and the original disaster protection function.

Today, four basic criteria are used to select a backup method: time, size, capacity, and media. Each of these factors has a different emphasis, depending on the market for which the system is designed.

Regardless of whether the disk to be backed up is 5M bytes or 500M bytes, the generally accepted requirement for backup operations is less than 30 minutes. As larger disks are being backed up, the device must have increasingly higher transfer rates. Backup time is also dependent upon system parameters. Therefore, how fast the device itself runs is often not of prime importance. What really counts is the average transfer rate for the system in which the backup device is used.

As disk drives are becoming smaller, the backup unit is also shrinking. With 5¼" Winchesters starting to approach capacities over 50M bytes, their

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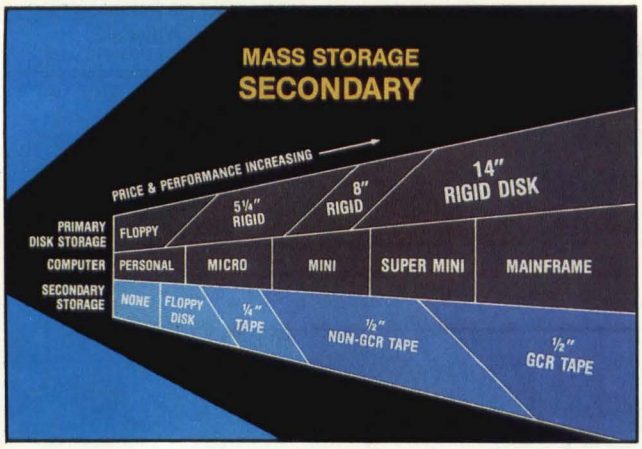


Fig 1 A gaggle of factors are involved in choosing appropriate secondary storage methods for any system. System integrators must not only be mindful of traditional issues of cost, size, and performance, but must also be cognizant of new backup alternatives. The price of ignorance is reduced competitiveness.

backup devices must meet the basic criteria of time, size, etc, while retaining a basic 5¼" form factor. Eight-inch Winchester products will require backup devices with form factors roughly their own size and, of course, the analogy also holds true in the 14" sizes.

As a partner to the Winchester, the backup product must have a complementary capacity ratio. Therefore, any device that meets the basic time and size requirements—and within three media changes meets the capacity requirements—is acceptable. This is easier said than done.

Media availability is, without question, the number one concern today. However, in backup device selection the question of media becomes more than just availability. If the device is to be used for software distribution or interchange between another system, then the media must be not only form but format compatible; thus, it falls within an ANSI specification. If interchangeability is not an issue, then availability and price become the major concerns. Half-inch tape is generally accepted in the backup arena. Although 3M quarter-inch cartridges are also being widely accepted, they do not provide interchangeability between various system manufacturers. Other media, such as the half-inch tape cartridges, have been introduced, but at this point in time they are unique to the individual manufacturers and unavailable from multiple sources.

Secondary storage requirements vary, depending upon a wide range of considerations. To review these, the class of system must be categorized in a broad sense. Fig 1 illustrates the general system classification by capacity and performance. Systems depicted range from personal computers through mainframes. Fig 1 also illustrates the most common primary storage media encompassing floppy disks through high capacity 14" Winchesters. Also shown are the most popular secondary storage media in use today.

During the past few years, some interesting demands have been made by secondary storage users. These demands have helped shape the guidelines of secondary storage devices. Table 1 lists secondary storage design criteria in order of importance and indicates appropriate storage devices for systems with fixed disk capacity in excess of 5M bytes.

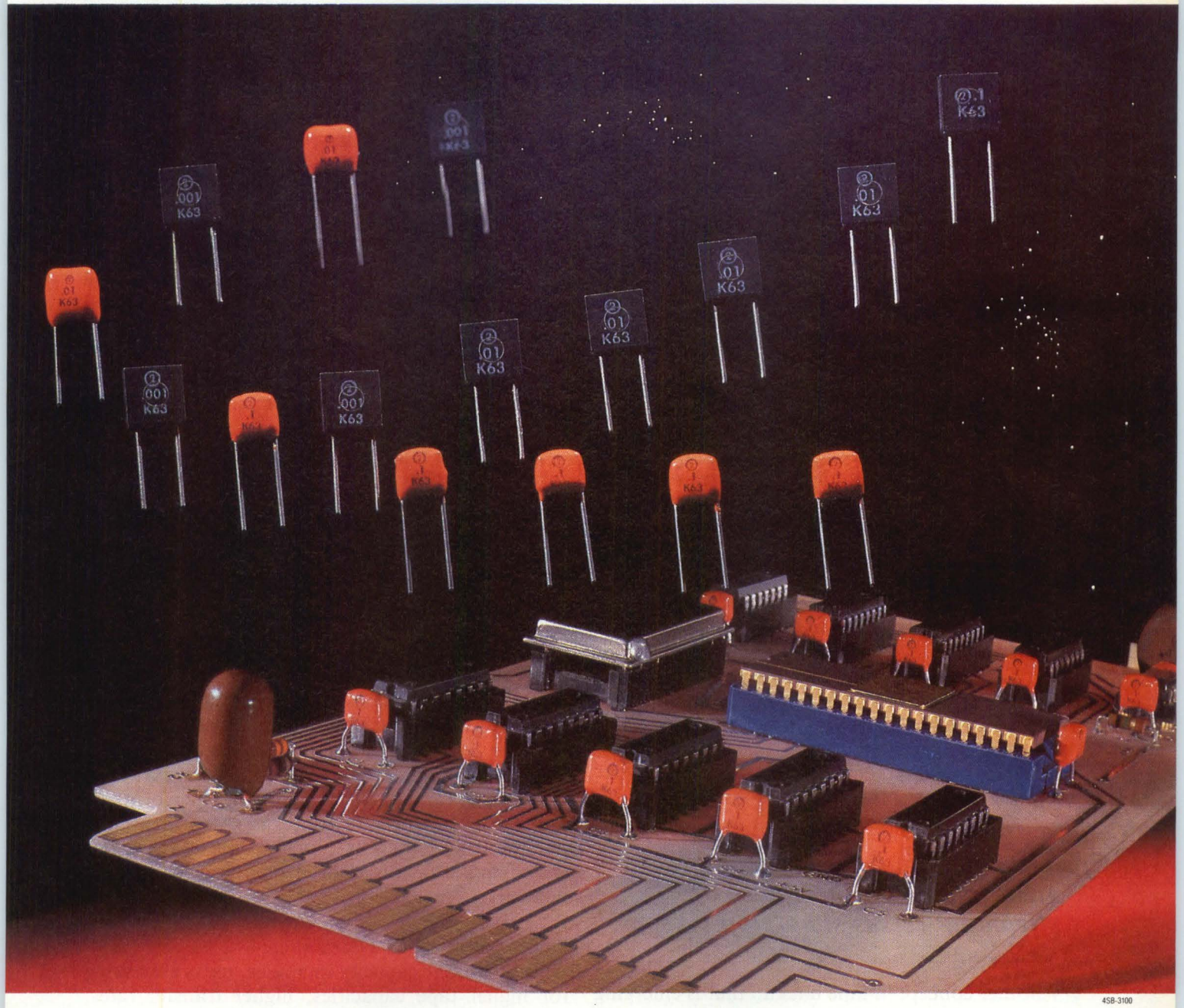
Half-inch IBM and ANSI compatible tape, 3M quarter-inch cartridge tape, and ubiquitous floppy disks are the standard media of secondary storage. The IBM half-inch tape, with ANSI compatible format, provides transportability and is available worldwide. In lower performance systems, the 3M cartridge has been accepted as a secondary media. With the events of the Quarter-Inch Compatibility (QIC) Committee, resulting in standardization of both interface and recording formats, the 3M quarter-inch cartridge tape may achieve the same acceptance as the half-inch tape that features ANSI and IBM compatibility. Thus, the three generally accepted media devices for secondary storage are floppy disks, 3M quarter-inch cartridge tape, and half-inch ANSI compatible tape.

TABLE 1

Secondary Device Selection Factors

	5M to 80M bytes	80M to 300M bytes	300M bytes
Secondary storage selection criteria	Cost Size Standardization Capacity Performance	Standardization Cost Capacity Size Performance	Standardization Capacity Performance Cost Size
Commonly used secondary storage device:	Quarter-inch tape Half-inch tape	Half-inch tape	Half-inch tape
Secondary device capacities:	20M/87M bytes	46M/87M bytes	87M/180M bytes

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Whether it is half-inch or quarter-inch cartridge tape, the secondary storage tape system falls into one of two categories: streaming or start/stop. The reasons for using streaming drives versus start/stop drives depend upon many factors, the most important of which is the fundamental system architecture. The software being used also has a great impact on the choice of streaming versus start/stop systems.

Streaming drives

Streaming drives (half-inch or quarter-inch) provide lower cost and higher performance. Increasing the data rate (performance) to keep the drives streaming generally means a dedicated file backup mechanism. However, the system must keep the transfer rate to the device high enough to prevent frequent repositioning. If this cannot be done, system performance suffers. (See "Built for Speed: Quarter-Inch Streaming Tape Drives," p , this issue.) Streaming device efficiency is achieved by writing data on the fly at higher average transfer rates than normally achieved with a start/stop drive. Multi-user systems, where high random disk activity tends to slow the access to disk files being transferred to tape, hinder the streamer's efficiency. In such cases, high speed streaming may actually result in lower throughput, due to the constant stopping and repositioning of the tape.

Start/stop drives, on the other hand, can start and stop after each record is written to or read from tape. Multi-user systems, or systems where the software prevents a continuous transfer of records, or systems where data are presented to the tape drive at varying intervals, are the major users of start/stop drives. The ability to start and stop, however, has a cost premium due to the drive's mechanical requirements. In many cases, a size limitation also exists.

The software being used also has a great impact on the choice of streaming versus start/stop systems.

Another concept in tape backup that is emerging is a synthesis of streaming and start/stop technology. Called CacheTape, Cipher Data's new method of backup uses the mechanics of the streamer to provide cost-effective secondary storage. At the same time, CacheTape integrates a sophisticated cache concept that emulates the start/stop drive. When the cache is integrated within the streaming tape drive, the result is a high performance tape drive at an extremely competitive cost. With the cache residing within the tape drive, the user can randomly transfer data to the tape drive at extremely high data rates. Transfers are not burdened with inter-record gap timings, start and stop ramp timings, or limitations in rate related to physical tape speed. Thus, the user, whose system architecture allows data streaming, can stream as desired if software or system parameters permit. Interrupted transfers that would burden a system with constant repositioning also realize improved performance. In actual benchmark tests, the CacheTape concept has increased the streaming device's performance (using existing start/stop software) by as much as 100% (see Table 2). The performance exhibited by existing start/stop tape drives can be increased by as much as 50%.

TABLE 2

Backup Benchmark Performance Times

Backup method	Total backup time
CacheTape M891 (half-inch)	6 minutes
Vacuum column (125 ips)	7 minutes
Vacuum column (75 ips)	9 minutes
Half-inch streaming drive	22 minutes

Benchmark figures in Table 2 represent the performance of several backup systems operating in real-world data transfer modes. All transfers were supervised by a DEC PDP 11/34 running under the RSTS operating system. Standard file save routines were also used.

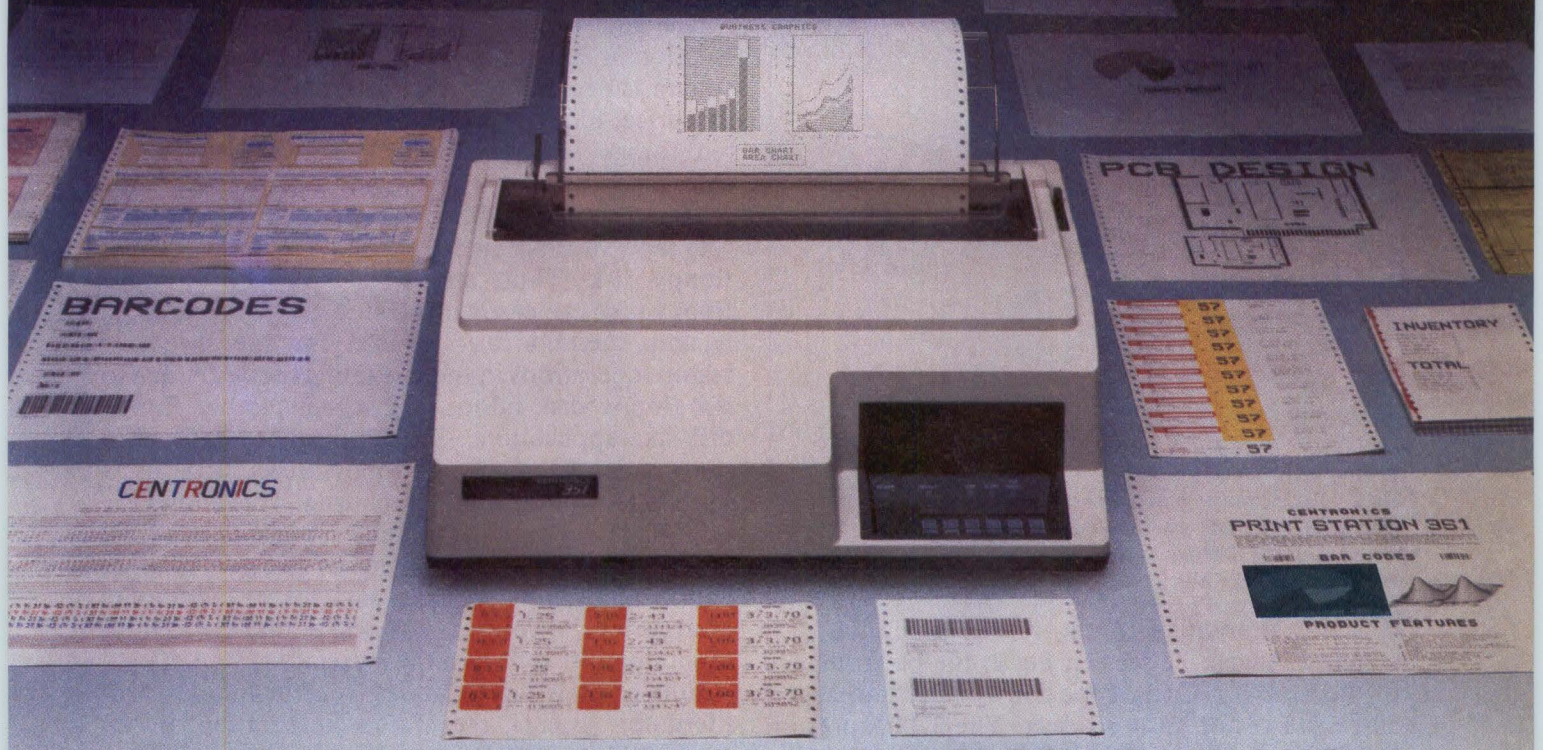
For the purposes of these benchmark tests, 16M bytes of data blocked in 4k-byte segments were transferred. The transfer involved a write operation followed by a verifying read operation. As the table indicates, the CacheTape system gave an excellent accounting of itself, especially when relative cost was taken into account. The CacheTape method of backup thus seems a viable alternative for systems where high performance and moderate cost are concerns. At present, this method is limited to half-inch products. It is likely to be available on quarter-inch products soon, however.

Higher performance systems

As disk storage capacity increases, users are asking for higher tape capacities, higher transfer rates, and lower-cost secondary storage devices. Where higher performance systems are involved, users are anxiously awaiting the arrival of the inexpensive 6250 group code recording (GCR) systems. Both Storage Technology Corp and Control Data Corp have announced inexpensive GCR tape drives estimated to cost $7000 in original equipment manufacturer quantities. Unfortunately, mid-range systems with a disk capacity of 160 to 300M bytes are still left without a reasonably priced secondary storage solution. Or are they?

The CacheTape concept, with dual-density 1600/3200 bpi, can provide a cost-effective high

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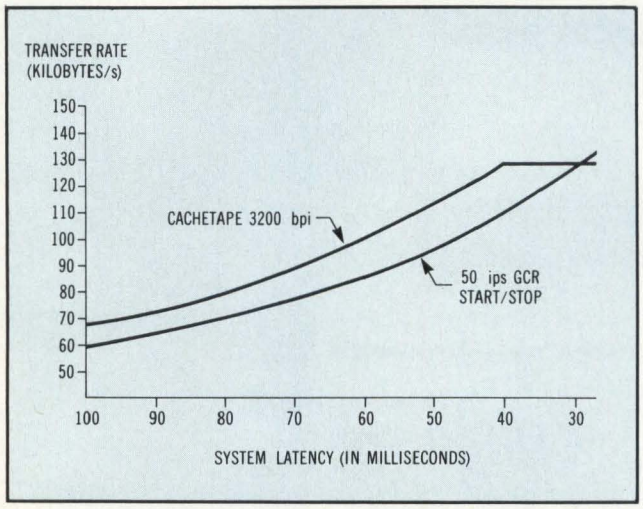


Fig 2 Performance comparison of CacheTape versus GCR scheme in terms of system latency reveals consistently higher throughput of 3200-bpi buffered tape system. A transfer of an 8192-byte data block was used as a benchmark.

capacity alternative to the rather expensive GCR systems. As can be seen in Fig 2, the performance of the 3200-bpi CacheTape consistently outpaces a 50-ips start/stop GCR product. The 3200 stores up to 87M bytes on a 10½" reel and supplies the user with a cost-effective alternative to GCR. It is also worth noting that GCR stores, on the average, 140M bytes on a single reel of tape, but at twice the cost of a CacheTape system. The 1600/3200 dual-density CacheTape units provide users with ANSI and IBM compatibility, as well as higher file save and restore capacities. Because of the higher price of GCR versus 1600-bpi tape drives, and the increasing need for reasonably priced high capacity tape storage for intermediate disk capacity systems (100M to 300M bytes), 3200-bpi tape systems can soon be expected to become a *de facto*, if not a formal, industry standard.

Quarter-inch cartridge tape products

Acceptance of the quarter-inch cartridge tape as a secondary storage device has recently been bolstered by the introduction of the 5¼" form factor units and the standardization of both the interface and recording format. The quarter-inch cartridge products, available in streaming and start/stop configurations, are under severe pricing pressure due to the rapidly falling cost of 5¼" Winchesters. With mini-Winchester disk capacities pushing toward 80M bytes, the quarter-inch cartridge tape manufacturers are introducing 45M-byte capacities. These latest introductions are designed to provide an effective secondary storage device that meets the objectives of size, cost, standardization, and capacity in the dynamic Winchester backup market.

Cipher Data's Floppy Tape quarter-inch cartridge tape drive provides an alternative backup solution in many applications, especially where the system is pressed for high capacity and extremely low price. FloppyTape offers 20M bytes of formatted storage, in a 5¼" form factor, on a 3M quarter-inch tape cartridge. The main advantage of this scheme is that no additional controller is required. The tape interface and recording format emulate a floppy disk. Thus, any system presently using a floppy disk can easily integrate a FloppyTape. This backup method can be used for file save and restore operations in the streaming mode or, due to the floppy disk addressing scheme, other floppy disk-like applications. The FloppyTape appears to the system as multiple floppy disks with user-selectable soft-sectored formatting. This allows the user of single- or multiterminal systems to integrate a FloppyTape with 20M bytes of storage, random addressability, no requirements for an additional controller, minimal software changes, and minimum disruption to the system.

Finally, it is worth noting that in today's proliferating systems, the ease of integration of any secondary storage device is becoming more important. Peripheral manufacturers are recognizing the importance of compatibility with the primary storage device. Following the move in the Winchester disk market, both quarter-inch and half-inch tape products that feature intelligent interfaces such as the IPI, ISI, or SCSI will be introduced, making them compatible with the primary devices on a common bus.

For users the benefits will be great. As the backup tape industry strives to meet the needs of the Winchester equipped system, the inevitable battles of falling costs and increasing functions will be fought. Quite likely, the only real winners will be the beneficiaries of the new technology—the users. But that, after all, is the beauty of a free market.

In order to resolve the many facets of secondary storage device selection, innovation in several areas will be required. Standardization and capacity issues are well on their way to being resolved. Resolution in other areas like pricing, start/stop versus streaming formats, system compatibility, and ever higher performance requirements need more attention. And, in the blooming mid-range system market, they no doubt will get it.

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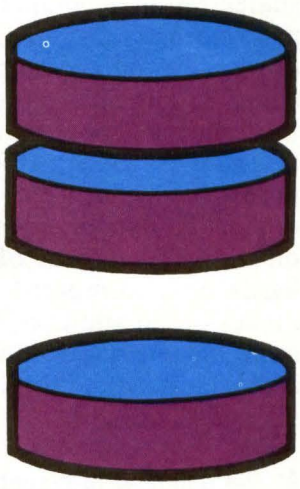


MANAGING STORAGE EN MASSE WITH A SHARED SERVER

Incorporating parallel processing, bit-slice technology, and queued instructions into mass storage control has a dramatic result. A single server can attend to several host processors while overseeing scores of storage peripherals.

by Ralph L. Platz, Robert C. Blackledge, and James H. Hughes

Performance improvements on both sides of the input/output bus are demanding that mass storage controllers expand their role. As disk drive capacities swell, and higher transfer rates become mandatory, controllers are getting faster. As multitasking systems proliferate, controllers are assuming a greater role in system resource management and thereby growing smarter. Finally, that most demanding of all system elements, the user, is bringing extremely high expectations of reliability and data integrity to bear on mass storage peripherals. No data loss whatsoever is tolerable in modern computers.



Given the expanded role mass storage controllers are playing in today's systems, a new way of conceptualizing them is in order. The traditional view of a controller serving a single host, while administering to a few disk or tape drives, is no longer valid. Now, the concept of shared servers that aid many host central processing units (CPUs) and oversee the activities of scores of disk units seems more appropriate.

This latest generation of controllers performs physical access and data transfer management functions well beyond the scope of traditional

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James H. Hughes is a consulting engineer at Digital Equipment Corp. He holds a BSEE from the University of Manchester, England.

controllers. For this reason alone, a more fitting moniker for these devices may be "shared servers."

To accommodate these expanded system responsibilities and throughput requirements, new mass storage subsystem architecture is being devised. One of the most promising schemes to date is the incorporation of parallel processing into mass storage server architecture. The net result of this is concurrent performance of many mass storage functions and heightened efficiency of system peripherals.

The first mass storage server designed specifically for use in Digital Equipment computers is the HSC50. It is an intelligent standalone node capable of handling as many as 24 magnetic disk or tape storage units. This server also meets the requirements of the company's Digital Storage Architecture (DSA) and thus provides error handling and diagnostic and maintenance functions characteristic of DSA mass storage subsystems. The HSC50 is built in accordance with the Digital System Interconnect Architecture (DSIA). The DSIA provides shared CPU and storage resources in multiprocessor systems. For high end systems, the DSIA physical link is the computer interconnect (CI) external bus. This bus permits CPUs and mass storage subsystem nodes to communicate at speeds up to 70M bps.

Function and performance objectives for the HSC50 server were established by its position at the intersection of two architectures, DSIA for the shared-resource computer system and DSA for the mass storage subsystem. Early on, it was clear that the large processing ability needed in the server could be furnished either by one relatively powerful processor or several smaller machines. The decision to design the server around parallel processing—concurrent execution of tasks by two or more co-operating processors—was based mainly on the lower cost of off-the-shelf microprocessor hardware as compared with a single, custom built processor. In addition, parallel processing offers a more flexible server configuration that can readily accommodate additional functions and mass storage devices.

At the DSIA/DSA intersection

The multipath topology of a DSIA system (Fig 1) provides communication among as many as 16 nodes over the CI bus. These nodes can be either CPUs or other mass storage servers. The DSA mass storage units currently supported by the HSC50 server are a 205M-byte removable disk drive, 121M-byte and 456M-byte Winchester-type drives, and a new 145M-byte tape drive.

The CI bus is dual-railed and supports simultaneous communication between any two distinct pairs of nodes (other than server to server). And, thanks to their dual ports, the DSA disk drives can be linked to two servers, although a drive can only be controlled by one server at a time. As a result, one or more CPUs may concurrently access a particular disk drive, and more than one server may support the same host. Moreover, if one server shuts down, all disk accesses can be rerouted.

In contrast with the daisy chain configuration of conventional mass storage subsystems, drives in a DSA subsystem are radially connected to their servers. Thus, the failure of one drive does not affect other drives. Similarly, access to one drive does not necessarily prevent concurrent accesses to other drives.

With its unique placement at the intersection of DSIA and DSA, the HSC50 server supports global sharing of mass storage resources among the CPUs. The mass storage units in a DSIA system are as accessible to each CPU as are any of its dedicated peripherals.

The flexibility of access also extends to the physical locations of nodes and drives. A CPU and server can be up to 275′ (83 m) apart. A server and drive can be separated by as much as 80′ (24 m).

Parallel processing taps shared resources

In performing its functions, the HSC50 server must not handicap CPUs or mass storage units in any way. It must accept all command requests for read/write operations as they are received from CPU nodes, and it must handle data transfers in either direction at the CI bus speed of 8.75M bps. On the mass storage side, specs for bus bandwidth are 3.125M bps. As there are no data buffers in the drives, the HSC50 must handle data transfers at the drives' native transfer rates.

The process of performing a data transfer involves a number of specific tasks in the server.

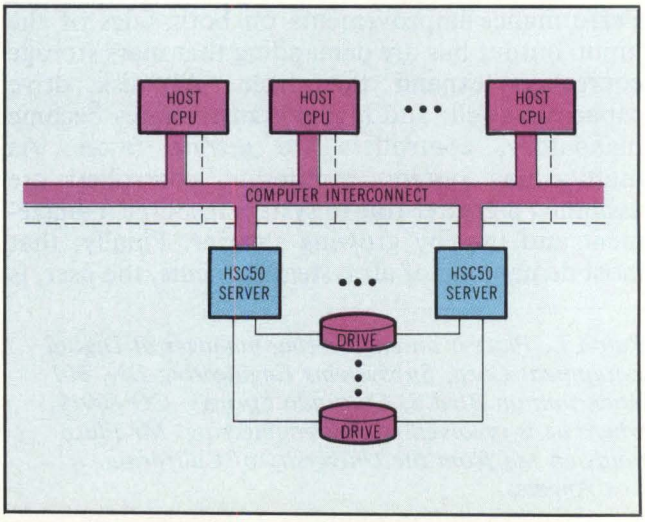


Fig 1 All CPUs linked to a CI bus have access to any magnetic disk or tape drive unit connected to a mass storage server. Two servers may access the same drives through their dual ports.

These tasks include mapping logical block numbers to physical disk locations on specified drives, performing seek operations from cylinder to cylinder on each drive, managing and optimizing data transfer operations to and from specified sectors on each cylinder, validating data, error recovery, and running diagnostics. The server performs automatic diagnosis both at timed intervals and when it detects hard errors. Diagnosis may also be performed on demand, either offline or concurrently during normal operation. When an error is detected, the server sends a log message to the host CPUs.

The random, yet simultaneous nature of these tasks strongly suggests parallel processing as a more time-efficient operating mode than sequential execution by one high speed processor. First, all of the tasks are distinct functions that can be assigned to separate processors. Second, physical data transfer is a critical realtime task. This task cannot share a processor's time with several other tasks since transfers cannot wait. Third, CPU operations are likely to be in different stages of processing at any given time. Many tasks will thus be executing, or waiting to be executed, at a given instant.

Fig 2 shows how these tasks are divided among three types of processors. These tasks include an input/output (I/O) control processor, the disk (or tape) interface microprocessors, and the host interface microprocessor. There may be as many as six disk/tape interface microprocessors, each of them responsible for handling transfers through a data channel that accesses as many as four disk or tape drives.

All processors are linked by two independent internal buses—the control bus and the data bus. Through these buses each processor has independent access to two shared random access memories (RAMs). The 128K-byte control RAM stores queues, tables, and command structures shared by the processors. The 128K-byte data RAM temporarily stores data that are in transit between mass storage drives and host CPUs.

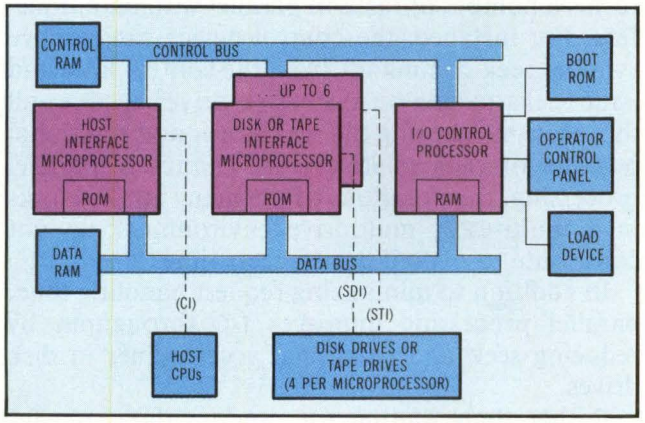


Fig 2 Parallel processing increases I/O throughput by dividing tasks among three types of processors. One manages I/O, one oversees host CPU interface tasks, and one supervises a data channel to disk or tape drives. As many as four drives can connect to each of six data channels.

Processor functions are multifarious

The I/O control processor manages operation of the server by interpreting requests from the CPUs and setting up command queues in the control RAM. These queues are accessed by the other processors. The disk or tape interface microprocessors have the realtime responsibility of transferring data on the data bus between the storage units and the data RAM. With parallel access to the control RAM (via the control bus), these microprocessors also overlap the exchange of command and response messages with all storage units. Furthermore, the disk microprocessors monitor the rotational positions of all disk drives, and oversee rotational optimizations between disk drives, as well as arbitrating multiple request modes to each drive unit. The host interface microprocessor transfers data between the host CPUs and the control and data RAMs.

There is no hardwired connection between any of these processors. The I/O control processor maintains high level commands in queues in the control RAM, but it does not know or care what detailed, low level operations they will initiate. Similarly, the micros do not know where the commands they are executing have come from. Once it has set up an I/O transfer operation, the I/O control processor does not intervene in data transfers during normal operation. It does, however, handle all errors, exception conditions, and most diagnostics.

To support this division of labor, the I/O control processor embodies a good deal of intelligence. It does not need to execute particularly fast, though. On the other hand, interface micros need not be too intelligent, but must execute quickly. About 95% of the total code (by volume) is assigned to the I/O control processor, with only 5% assigned to the micros. Conversely, more than 95% of the total instructions executed run on the micros. The I/O control processor is therefore designed as a general purpose, vertical element. It executes the full PDP-11 instruction set (although it cannot be programmed by the user). The interface micros, on the other hand, are horizontal components composed of 2911 bit-slice components.

The 256K-byte main memory of the I/O control processor lies in RAM since it is writable. The server begins operation when a boot read only memory (ROM) initiates loading of startup diagnostics and operational firmware from a tape cassette. The major difference between tape, disk, and host interface micros is the coding of their ROMs.

The bandwidth of the data bus is determined by the maximum speed needed to handle multiple data

transfers at the specified rate. Compatibility with the internal clock rate established for synchronous operation of all modules within the server is also retained. Its selected bandwidth of 13.33M bps permits the data bus to handle as many as three sustained realtime read bursts from disk drives with enough extra speed for the less time-critical transfers to the CI bus. Communication need not be as fast on the control bus, so its bandwidth is 6.67M bps.

Message and data packets are transmitted between the server and the disk drives, tape drives, and host CPUs at speeds corresponding to their own clock rates. Once packets are stored in control or data RAM, however, they have entered the server's synchronous environment. Here, memory accesses, bus transfers, and fetch and execute operations on all processors run at a fundamental cycle time of 150 ns. Since all the server's processors have 16-bit data paths, the 150-ns cycle is compatible with the 13.33M bps speed of the data bus.

The 128K-byte data RAM uses 16K x 1 static devices accessed by a 150-ns cycle time data bus. The control bus speed is half that of the data bus, and the control RAM is accessed at a cycle time of 300 ns. The 128K-byte control RAM uses 64K x 1 dynamic chips that cost less, occupy less space, and use less power than the data RAM. Both these memories can be accessed simultaneously by different microprocessors.

Further parallel processing

Each disk, tape, and host interface microprocessor consists of dual microsequencers (Fig 3). This duality introduces a second level of parallel processing and further increases I/O throughput.

Fig 3 illustrates the structure of a disk interface microprocessor. The control microsequencer oversees control RAM accesses and the drive state data received from the drives connected to the interface microprocessor. The control RAM is accessed to retrieve transfer commands intended for its drives, and to forward completed commands for further handling by other processors. The drive state data consists primarily of sector pulses and index pulses that locate in real time the exact position of each drive's read/write heads.

The transfer microsequencer in Fig 3 is free of process management tasks. It is dedicated to handling data transfers on the data bus. These transfers occur at the disk clock rate and may or may not be as fast as the standard disk interface (SDI) rate of 3.125M bps. The cycling pattern of the dual microsequencers ensures that each fetches and executes an instruction in two 150-ns cycles. Since one fetches while the other executes, they can share a common ROM, output instruction register, arithmetic logic unit, and other logic. There is a great

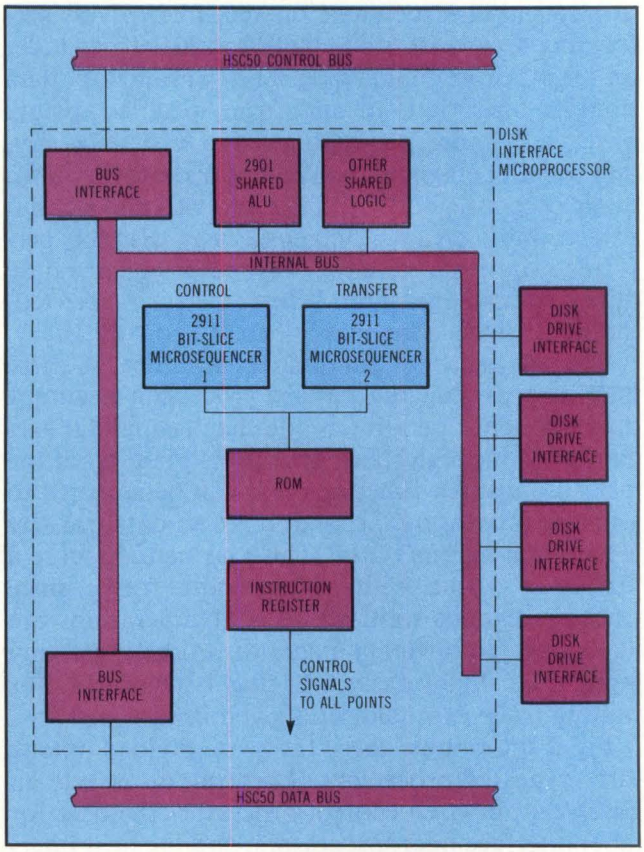


Fig 3 In the second level of parallel processing, the tasks of each disk interface microprocessor are divided between dual microsequencers. Microsequencer #1 handles the control functions involved in data transfers, and microsequencer #2 is dedicated to the actual realtime transfers.

difference between these microsequencers and those in conventional controllers where control and transfer tasks occur in sequence, rather than in parallel.

In the HSC50, the control microsequencer performs a number of tasks in parallel with data transfers. For instance, the control device can retrieve cylinder seek commands from the control RAM and issue seeks to one or more disk drives. It does all this while monitoring the seek status and rotational position of each of its drives. Thanks to parallel processing, the durations of the many control tasks in a multi-CPU, multidrive environment do not contribute to overall drive access time.

In addition to minimizing request handling time, parallel processing improves I/O throughput by reducing seek and rotational access times in disk drives.

Rather than waiting for random data transfer requests, the HSC50's I/O control processor optimizes throughput by dynamically inserting seek commands and data transfer requests into ordered instruction queues. Thus, seek and rotational positioning times are minimized. To

accomplish this, a command buffer in the HSC50's control RAM maintains a constantly changing queue of as many as 1000 requests, called mass storage control protocol (MSCP) command packets.

Each MSCP packet in the request queue is examined by the I/O control processor to identify or calculate the particular drive to be accessed (out of 24), the particular cylinder, the starting sector address and number of sectors involved (one sector contains either 512 or 576 data bytes). Packets indicate whether access is to be a read or write operation. As shown schematically in Fig 4, the cylinder number, in this case 200, is placed in its proper sequence in the seek queue for the specified drive (10). Then, a read or write indicator is placed at the location of the starting sector in the rotational access table for that cylinder. Both the seek queue and rotational access table reside in control RAM, and contain cylinder and sector indicators deposited for requests that have been examined but not yet acted upon. Although both the queues and tables are constantly changing, the seeks and rotational accesses are always in numerical (and physical) sequence.

Knowing the cylinder positions of the heads on all drives, and the instantaneous rotational positions of the disks, the I/O control processor initiates seek assignments to drives so that seek time will be minimized. If two or more drives in a data channel are on cylinder (no head movement is needed for either), rotational optimization provides that the head that is rotationally closest to the first sector for read or write starts its data transfer first. This happens regardless of which CPU request was received first.

A request fragmentation technique reduces rotational latency of very long data transfers. Requests specifying transfers spanning more than a fixed number of sectors are automatically segmented before they are loaded into a rotational access table. The read or write transfer then begins at the first sector of the next fragment, rather than at the first sector of the entire request. The minimum size of requests to be fragmented, and the number of sectors in a fragment, are determined by the tradeoff between the extra processing time needed for fragmentation and the resulting reduction in rotational latency.

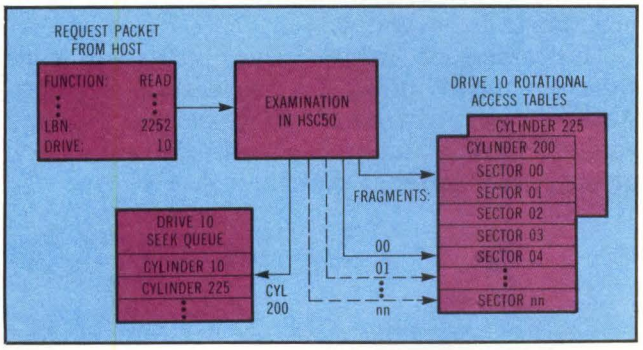


Fig 4 Execution of MSCP requests in the I/O control processor include assigning each new request ordered positions in the seek queue of the specified drive and in the rotational access table for the specified cylinder in that drive. I/O throughput is optimized by subsequent reduction of seek time and rotational latency.

The I/O control processor monitors the state condition of each disk interface microprocessor. Whenever any disk interface microprocessor is running low on queued transfer requests for drives connected to its data channel, the I/O control processor dispatches additional requests to the queue.

Software improves processor communications

In closely coupled processors using shared memory, provision must be made to ensure successful processor to processor communication. For example, one processor must be prevented from reading particular addresses before another processor has finished writing to these same locations. This is easily accomplished with a software lock.

The lock cycle consists of a read operation followed by a write of a special lock value. If the lock read indicates that a lock value is already in place, an interlock operation by another processor is in progress and the second processor must wait. If the lock read indicates no lock value is present, the lock value is immediately written and other processors locked out.

There must also be provision for transmitting directives or data from an originating processor to a target processor through shared memory. To do this, each processor has been assigned its own linked list queue in control RAM, so that the originating processor simply places a message in the target processor's queue, following conventional linked list algorithms. The originator need not know anything but the address of the target's queue, and the recipient need not know anything but the contents of the message.

The layered protocol structure in Fig 5 illustrates the software relationships between a CPU node and HSC50 node in a DSIA system. With one exception, the layers are similar to those in a DSA mass storage subsystem based on the UDA50 controller. The MSCP layer is identical. In place of the Unibus port architecture, the systems communication architecture (SCA) protocol establishes node to node "circuits" and process to process "connections" for delivery of messages between the servers and the CPUs in the system. The standard tape interface (STI) protocol is added for tapes.

The disk class and tape class drivers in the host establish "connections" with their corresponding "servers" in the HSC50 and construct message packets (commands or data) in the MSCP. The CI port drivers in the host CPU and HSC50 handle transmission of the messages over a virtual "circuit." Each class driver handles all DSA storage units of a

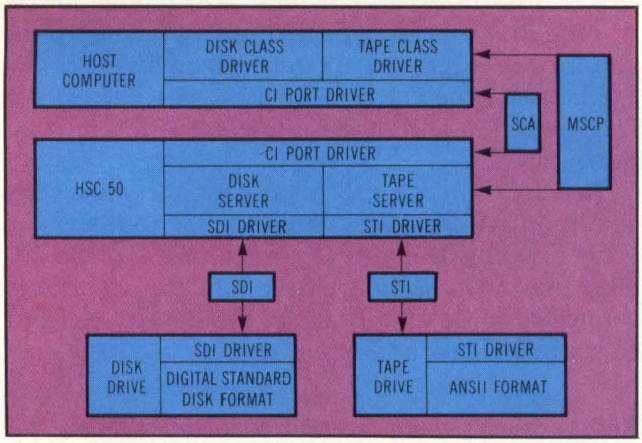


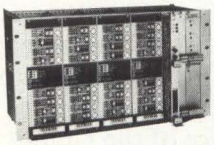
Fig 5 Layered software architecture offers maximum flexibility in connecting DSA disk and tape drives to CI buses. The software establishes a virtual circuit between the HSC50 node and the CPU node on the CI bus.

given type—since all unit specific firmware is located in the unit itself. Moreover, all diagnostics and error detection, correction, and recovery, which are host resident functions in a conventional mass storage configuration, are performed by the disk and tape servers in a DSA subsystem.

On the mass storage side, command and data messages move between the HSC50 and each individual drive via firmware drivers. These drivers support the SDI or STI protocol over an SDI or STI bus.



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The Digital Standard Disk Format (DSDF) describes how a physical disk is partitioned into units of data storage. The host computer's operating system sees a fixed number of logical blocks (or sectors) throughout the life of the drive, a characteristic made possible by powerful error-handling ability in the HSC50 server and an automatic revectoring procedure for replacing bad blocks. DSA tape drives, rather than using a proprietary data format such as DSDF, are formatted according to ANSI standards.

Data channels and board modules

The number of disk or tape drives per data channel is based on the physical capacity of boards in the HSC50 server cabinet. A data channel having four drives per disk or tape interface microprocessor was selected because the hardware of four SDI/STI interfaces fits on one board. The PDP-11 I/O control processor fits on one board and includes an arbiter for eight bus requesters. These bus requesters are allotted to the I/O control processor, to the host interface processor, and disk or tape interface processors.

A single memory module contains the 128K-byte control RAM, 128K-byte data RAM, and 256K bytes of program memory for the I/O control processor. The host interface microprocessor and associated hardware occupy three modules and connect to four external cables, one "in" and one "out" for each of the two CI paths.

A maximum configuration of the HSC50 mass storage server currently fills 11 of the 14 module slots available in the board cage. This leaves three slots available for expansion. The HSC50's parallel processing configuration permits further performance improvements. Upgrading the I/O control processor with more powerful members of the PDP-11 family is one option. Moreover, with advances in large scale integration technology, the maximum number of disk or tape drives per data channel, as well as the maximum number of channels, might be increased.

This milestone in the development of mass storage control introduces the era of the mass storage server, where many host CPUs are teamed with scores of storage peripherals; the foundation of such architecture is the shared server.

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For more information contact:

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CIRCLE 142

VRC

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Memory Products for Systems That Can't Stand Failure



Microcomputer development system has complete set of tools

Desktop microcomputer VME/10 serves three purposes. First, it is a complete development system for system OEMs working with Motorola 8- and 16-bit microprocessor and microcomputer chip sets. Second, it serves system integrators as a frontend microcomputer for use with larger equipment. And third, it can be a basic microcomputer for OEMs who add customized I/O and special software for dedicated applications. Although it now provides both 8- and 16-bit software, hardware, and instrumentation support, the microcomputer uses the MC68010 16/32-bit microprocessor. Therefore, it is upward compatible to 32-bit system configurations, such as the upcoming MC68020 microprocessor.

The VME/10's memory allows multitasking and multiprogramming. It features built-in graphics capabilities and an optional 12″ (38-cm) video display for many systems. Multislot cage and modular architecture permit system tailoring to any desired level of complexity through compatible add-on modules. System performance combines the power of the M68000 processor family with the international VMEbus standard and the full VERSAdos operating system, providing realtime operation and high level language compatibility. A separate built-in I/O channel, unique to the system, frees the VMEbus from handling the slower peripherals and significantly improves overall system capabilities.

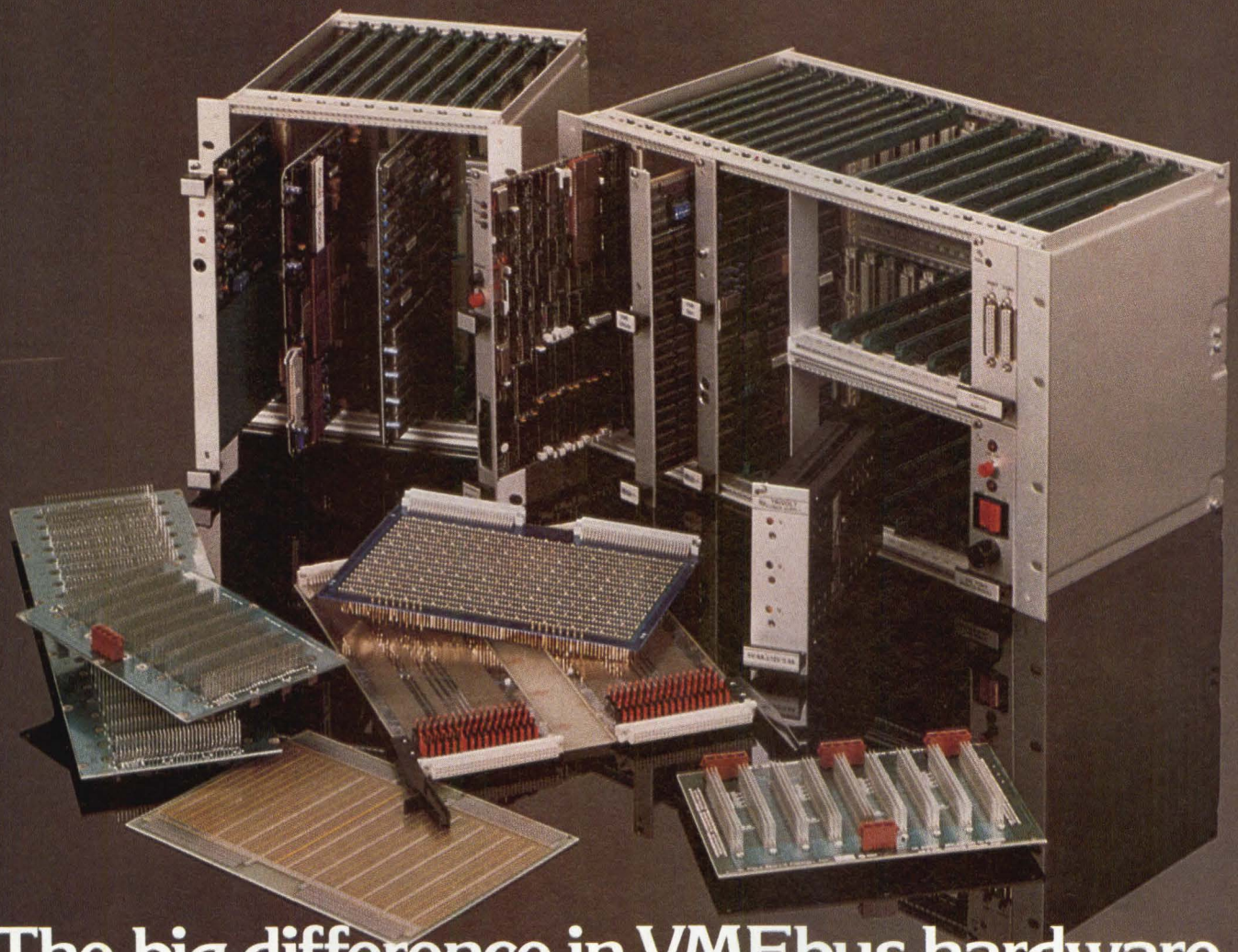
A basic system consists of three interconnected physical elements: system control unit, keyboard, and display unit. The system control unit, key to the system's flexibility and expansion capabilities, contains a system control module (together with VMEbus- and I/O-channel interface circuits), a 15M-byte fully formatted Winchester disk drive plus an 800k-byte fully formatted floppy disk drive, and a chassis (with power supply) that permits system expansion with up to 5 VMEmodules and 4 additional I/O modules.

Containing the MC68010 microprocessor and MC68451 memory management unit, the system control module's power permits several development tasks to proceed simultaneously (editing, program development, and system debugging) with full protection for each. A dual-port controller that allows shared access from both the local bus and the VMEbus, along with 384K bytes of onboard dynamic RAM, permits expansion to a high performance multiprocessor system by adding modules from the VMEmodule line of board level products.

VMEbus and I/O channel interfaces provide configuration flexibility for a multitude of end applications. For example, with VERSAdos and the VMEmodule IEEE 448 GPIB controller, the microcomputer comprises a base system suitable for monitoring and controlling laboratory instruments. It can also be used to perform complex calculations on resulting experimental data, and then to graphically present the results.

I/O channel modules (A-D, D-A, input, ac output, dc input, and dc output) plus inherent graphics display capabilities provide the system with basic features for data acquisition, monitoring, and control applications. By adding I/O channel modules to provide serial communications and printer support, the microcomputer can serve as the host or supervisor for several lower level controllers, remotely located in an overall distributed processing configuration. The complete development tool set is

(continued on page 276)



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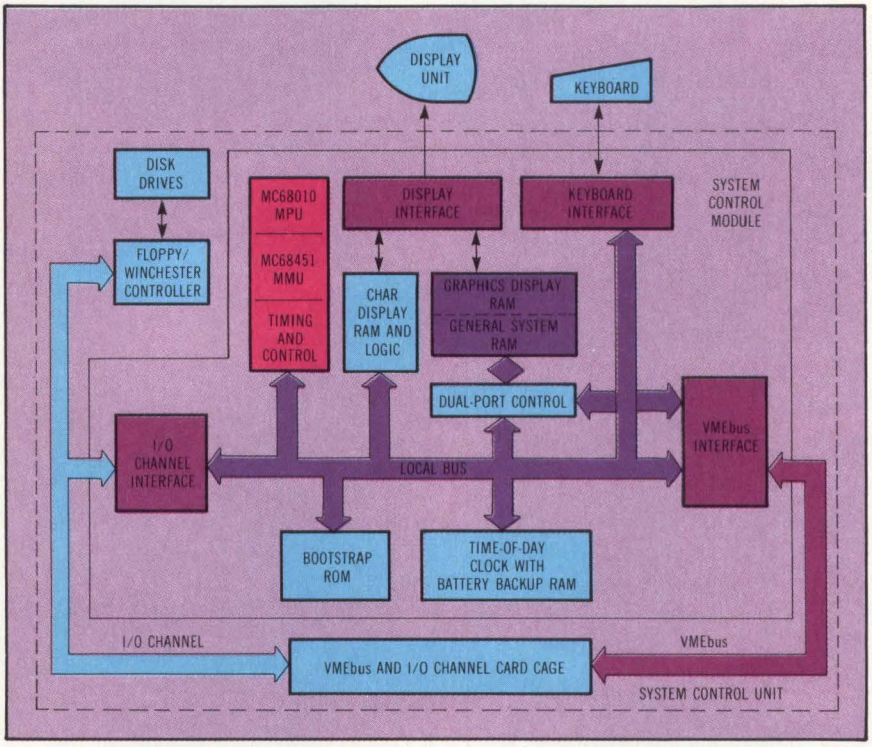
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VME boards supplied courtesy of Mostek, Motorola & Signetics

CIRCLE 143

(continued from page 274)



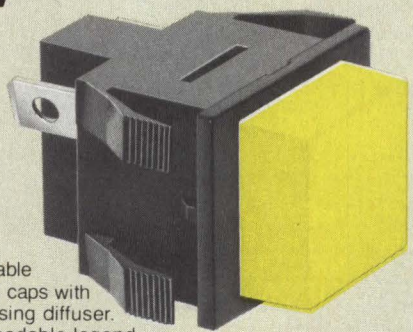
A single 12″ x 16″ (30.5- x 40.6-cm) card in the Motorola VME/10 microcomputer development system combines main system processor with memory management unit, 384K-byte RAM, and 2 bus interfaces.

flexible enough to use as a target system or as a standalone development system for all Motorola 8- and 16-bit MPU/MCU chip sets.

Present system software includes the VERSAdos realtime operating system, MC68000/68010 macro assembler, MC68000 Pascal compiler, linkage editor, CRT editor, symbolic debugger, MC68000 FORTRAN, M6800 family cross-assemblers, and PROM programmer drives. A UNIX System V operating system with C compiler and an M68000 BASIC compiler are planned for the future. **Motorola Inc, Semiconductor Products Sector,** 5005 E McDowell Rd, Phoenix, AZ 85008. **See at NCC Booth W6114**

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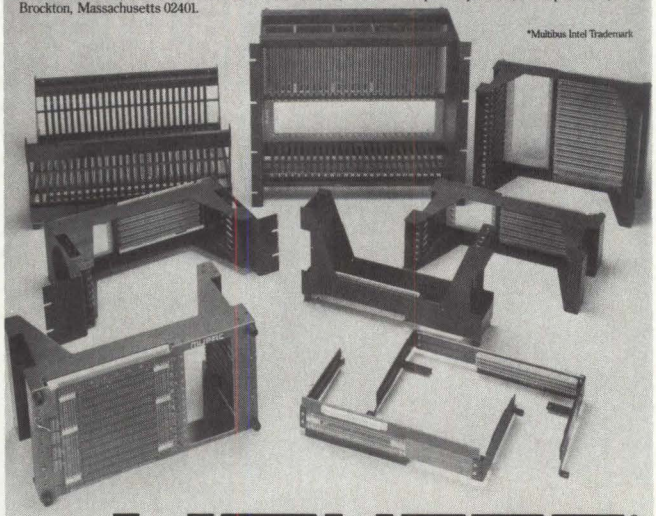
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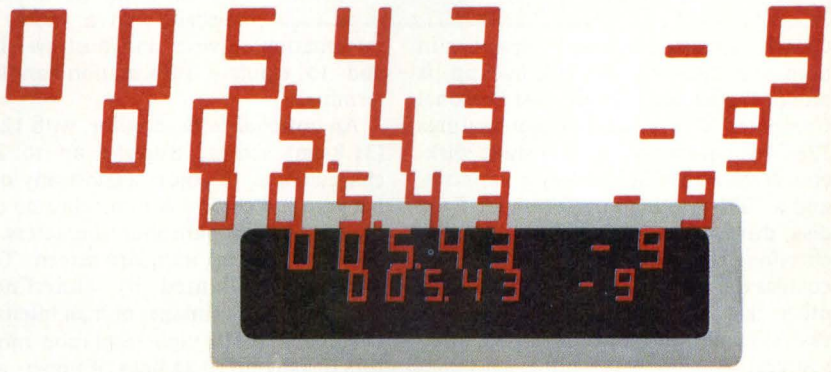
Introducing the 50 ps scope.

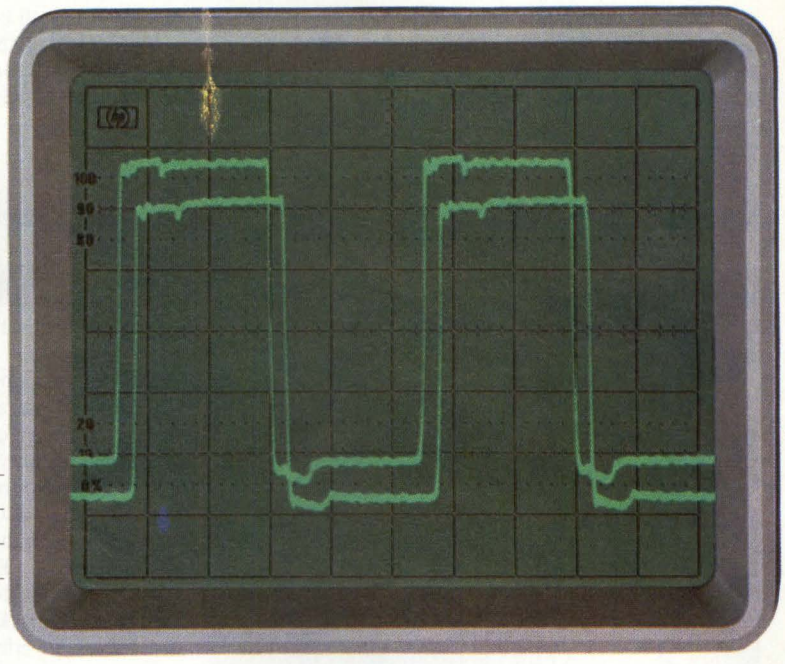
HP's 1726A time-interval oscilloscope solves this timing limitation with a revolutionary approach. Its new method of making timing measurements is based on combining HP counter technology with HP's advanced oscilloscope triggering circuits. The results? New levels of accuracy (±50 ps), resolution (±10 ps), and repeatability (±30 ps). All this in a portable package that won't clutter your bench or test station. Typically, the 1726A's accuracy is a factor of ten improvement over most laboratory scopes, including the one you're probably using or planning to purchase.



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TIME INTERVAL	500 ps	5 ns	1.2 μs
1726A Accuracy	±50 ps	±50 ps	±50 ps
1726A Resolution	±10 ps	±10 ps	±10 ps





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CIRCLE 146

Small computer storage capacity increased by nine



Greatly increased storage capacity, in both user memory and disk backup, is one of the advances in the IBM Personal Computer XT. A base system features 128K-byte memory, a dual-sided diskette drive with a 368,640-byte capacity, and a 10M-byte high performance fixed disk drive. Also included is an asynchronous communications adapter that enables the system to communicate with other IBM Personal Computers, larger IBM systems, and outside information sources.

Three of eight expansion slots are used for the already installed communications adapter, and the diskette and fixed disk drives. With an optional expansion unit and maximum user memory, the XT can store nearly 22M bytes of information, or the equivalent of 11,000 double-spaced typewritten pages. Synchronous data link control (SDLC) and binary synchronous communications (BSC) adapters are also available. With appropriate programming, these allow the XT to communicate with a variety of information services and host systems, and to emulate information-handling terminals.

An optional color monitor, with 12.5″ (31.8-cm) screen, displays up to 256 characters in 16 colors against any of 8 background colors. A monochrome display has green phosphor characters on an 11.5″ (29-cm) antiglare screen. Text can be highlighted by underlined, blinking, reverse image, or high intensity characters. Both high resolution monitors display up to 25 lines of upper- and lowercase text with either 40 or 80 characters/line. Additional hardware options include single- and double-sided diskette drives, graphics printer, and other attachment cards and expansion units, as well as five international versions of the standard keyboard: British, French, German, Italian, and Spanish.

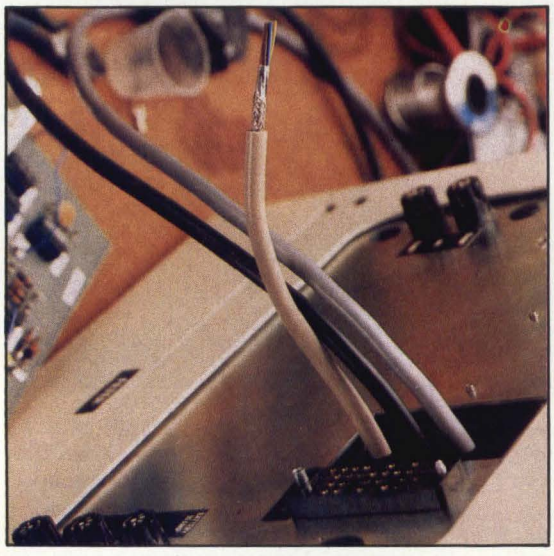
A version of the standard operating system, DOS 2.0, supports the expanded capabilities for both the XT and the earlier Personal Computers. This operating system also permits selected application programs to operate on both computers, as long as the necessary memory, diskette storage, and other system resources are available.

Other standard features include automatic power-on self-test of system components, BASIC language interpreter in ROM, built-in speaker, and keyboard attachment and keyboard. The system contains an Intel 8088 microprocessor with 4.77-MHz clock speed, 40K bytes of ROM, and 128K bytes of RAM. Memory access time is 250 ns, cycle time is 410 ns. **International Business Machines Corp, System Products Div,** PO Box 1328, Boca Raton, FL 33432.

See at NCC Booth N3526

Circle 321

Hazard-matched electronics cables fit specific applications



A series of computer, communications, instrumentation, and control cables, designed for electronics system protection, tolerates workplace abuse and hostile environments without conduit or other external protection. Five distinct cables in Alpha Wire Corp's Omniguard line are matched to specific applications. The manufacturer claims that using the right cable can increase productivity by cutting installation time and minimizing downtime caused by replacement of damaged cable.

For indoor applications, Omniguard 1 has a premium vinyl chloride copolymer jacket. Heavy duty industrial applications require the specially formulated thermoplastic polyurethane jacket of Omniguard 2. For direct burial applications, the Omniguard 3 jacket is constructed of an ethylene propylene copolymer. For intense cold and outdoor applications, Omniguard 4 uses a thermoelastomeric block copolymer compound for both the jacket and the insulation of the wire forming the core. Omniguard 5 uses matching jacket and core insulations of fluorinated ethylene propylene copolymer (FEP), the highest level in cable and system protection for the most demanding and harsh environments.

Fabricated in many UL, CSA, and OSHA acceptable styles, the cables are available in a wide variety of multipair or multiconductor versions or in solid or standard wire from 24 to 16. They can be supplied unshielded, foil shielded, or shielded with Suprashield. Foil shielding provides 100% coverage with polyester supported aluminum foil. Suprashield should be used where maximum shielding is required, as well as where cable is subjected to repeated flexing, tight bends, or rough handling. Suprashield is made of a polyester-supported aluminum foil with an overall woven tinned copper braid, and helps meet FCC Docket 20780 standards.

Two types of cable armor protect the cable from extreme mechanical abuse and water. AlphaLoc, which consists of a galvanized steel flexible interlocking armor plus an overall jacket of stabilized, vinyl chloride copolymer, should be used where exceptional mechanical protection is needed. AlphaBon has a hermetically sealed aluminum sheath, bonded to a tough ethylene-propylene copolymer jacket, for applications exposed to moisture. **Alpha Wire Corp,** PO Box 711, 711 Lidgerwood Ave, Elizabeth, NJ 07207.

Circle 322

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SV32AP	MOS	●	●									●			●	●							●	●	●	●	1			
SV128A	MOS		●	●								●					●	●					●	●		●	1			
SV512	MOS		●	●								●					●	●	●	●	●		●	●		●	●		1	
S11L/F	MOS				●	●	●						●				●	●			●		●	●		●	●			1
S11E/4	MOS				●	●	●						●				●	●	●		●		●	●		●	●			1
S750	MOS							●	●	●				●				●			●									1
✓ S780	MOS										●			●				●												1
1116B	CORE				●							●			●								●	●	●	●				1*
1132A	CORE				●							●			●								●	●	●	●				1*

*Memory is contained on a single board but requires space of two slots due to stack overhang.

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Lisp based computer solves AI problems



Previously, massive artificial intelligence problems had to be solved with a mainframe computer. Now a superminicomputer from Symbolics can be used, promising significant price/performance advantages. This Lisp based computer system is a high performance interactive workstation designed for symbolic rather than numerical processing.

It has a 36-bit tagged architecture with 32-bit data paths, and executes programs at an average of 1M high level instructions/s. Virtual memory contains 1,048,576 pages of 256 36-bit words. Basic system hardware features 2.3M bytes of MOS memory with ECC; one parallel and three standard serial I/O ports; a 10M-byte Ethernet interface, a graphics console that includes display, keyboard, and 3-button mouse; and a 169M-byte SMD-compatible Winchester disk drive. Each memory board has single-bit error correction and double-bit error detection. Up to 15 memory boards can be installed in the standard chassis for a total of 34M bytes.

Hardware options include 1280 x 1024 high resolution color graphics display, with 8-, 16-, 24-, or 32-bit/pixel mapping at up to 10 bits/color (R,G,B); floating point accelerator; and 9-track tape drive. Also available are a 20M-byte cartridge tape drive; 1200-baud autodial/auto-answer modem; 470M-byte Winchester or 300M-byte removable media disk drive (up to 4); IEEE 796 (Multibus) interface bus; and 10-page/min laser graphics printer.

An extensive, interactive programming environment includes sophisticated display system with multiple, overlapping windows for the black and white and color displays; realtime editor; and incremental compilers.

Zetalisp, an enhanced version of Lisp, is the primary language. Flavors, an object-oriented programming language, transcends essentials of Smalltalk in a manner fully integrated with the Zetalisp system. FORTRAN-77, C, Pascal, and Interlisp are also supported.

Zetalisp provides a single-level (virtual) memory system that automatically allocates memory space and reclaims memory space no longer needed by the running program. The system uses symbols or objects, with each symbol assigned to its own memory space. No syntactic or semantic distinctions are made between the system programming language and the application programming language. **Symbolics, Inc,** 9600 De Soto Ave, Chatsworth, CA 91311.

See at NCC Booth D2505

Circle 323

Development system combines logic analyzer and emulator



A redesigned 20-MHz, 32-channel x 1024-state analyzer, cross-triggerable with an analyzer-like 46-bit x 2048-line trace, is combined with an 8-bit emulator to form Advanced Digital Technology's 4009A microprocessor workstation. Trace record acquisition can be synchronous or asynchronous and records are displayed independently or in combined format with emulator trace records. When displayed together, activity traced in both records is shown in order of actual occurrence. Analyzer clocking is chosen from any of five internal sources or an external variable threshold input. Cross-triggering of analyzer and emulator traces is performed by programming pass-counted events from one trace into the event fields of the other trace.

Emulation techniques that ensure bus timing, closely matched to the emulated microprocessor, include timing stabilization through processor cooling, predictive clocking by a proprietary tracking oscillator, and reactive loading of time-critical signals. Emulator control and status display have been expanded to include single-step in trace and register display modes, data transfer to/from development systems, mask and generate reset and interrupts, trap illegal instructions, and monitor target system voltage and clock. All menus can be used without affecting emulation. An emulator memory overlay option includes a target system mappable pseudo I/O port.

An emulator trace operates independently of the emulator or is programmable to stop emulation. It includes trace search features and exclusion of DMA operations, or non-VMA and irrelevant cycles. Up to four events, selected from an operator-defined table of up to 48 labels, are detected by hardware comparison to control the trace or restart sequence or to identify trace-only conditions.

The workstation supports all Motorola 6809 and 6809/E microprocessors with one emulator card. Other microprocessors will be supported in the future by replaceable card sets. Response time at the emulator probe tip for the 6809 processors is within 5 ns. When cabled to the processor, an extended address socket on the emulator pod lets the operator use all emulator features over a 2M-byte range.

Four operator specified events can be used, each generated by hardware comparison of 39 bits. Event to event data acquisition has a 100-ns timing resolution. Battery backup protects specifications entered for emulator events, trace, memory overlay, and terminal configuration against power loss.

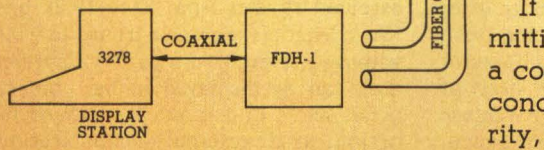
Included in the workstation are an emulator card set and pod assembly, emulator trace, supervisory controller, and RS-232-C port. Options include 16K-or 32K-byte memory overlay and other I/O port cards. **Advanced Digital Technology, Inc,** 13400 Northrup Way, Bellevue, WA 98005.

Circle 324

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- **Plug compatible with IBM series 3250, 3270A, and 3270B equipment.**
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- **Up to 1 Km operating range — virtually immune to electromagnetic interference.**

Versitron's FDH-1 (fiber optic digital hybrid) was designed to replace the coaxial transmission path in systems equipped with the IBM 3250 or 3270 series equipment. The simple installation of a fiber optic link provides two very important benefits to the user. First of all, the security level of the transmission link is greatly improved since fiber optic cables are inherently immune to conventional wiretapping techniques. Secondly, the system operating capability will be enhanced since fiber optic cables are impervious to virtually all types of electromagnetic interference. This includes, of course, interference from heavy duty manufacturing equipment and noisy adjacent cables.



Versitron's FDH-1 combines the high speed capabilities of a coaxial cable with the inherent advantages of a fiber optic cable. By interfacing directly to the coaxial cable, the FDH-1 appears totally transparent to the rest of the system; thus eliminating any operating restrictions.

If you're currently transmitting high speed data over a coaxial cable and you're concerned about data security, give us a call at (202) 882-8464 and get all of the details on how our FDH-1 will not only protect your data; but may also actually increase the operating efficiency of your entire system.



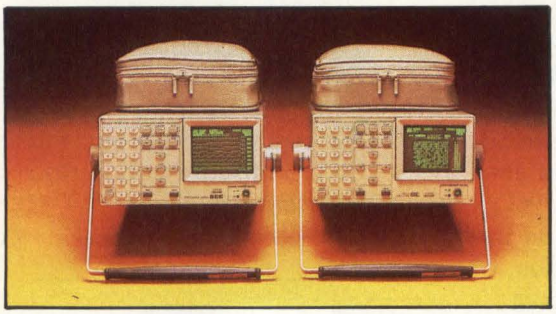
The FDH-1 is available in a variety of different enclosures, including a sealed unit specifically designed for EMI/RFI suppressed applications.

VERSITRON, INC.

6310 Chillum Place, N.W., Washington, D.C. 20011, TEL: (202) 882-8464
TWX: 710-822-1179

CIRCLE 148

Portable high performance logic analyzers



Boasting "ultra portability," the Sony/Tektronix 318/338 logic analyzers weigh only 11 lb (5 kg) each, yet provide 16 and 32 channels of data acquisition at 50 and 20 MHz, respectively. Both offer parallel state and timing features with optional serial state and character analysis, glitch capture, and 3 levels of triggering. Developed as a joint venture between Tektronix and Sony of Japan, the analyzers concentrate many of their functions in three LSI gate arrays. NEC manufactured two of these chips on special order, using advanced bipolar technology and 3-layer metallized wiring. Compared with commercially available IC packaging, these chips represent an 85% power savings and 86% space savings. One chip uses 828 gates to implement counting, multiplexing, and latching operations; the second uses 797 gates to implement clocking, timing, and decoding functions; while the third, with 679 gates and using silicon gate CMOS technology, implements all display controller functions.

In serial mode, both synchronous and asynchronous data acquisitions can be executed at rates from 50 to 19.2k bps. Word length is selectable from 5 to 9 bits with odd, even, or no parity. Captured data can be displayed in hex, binary, octal, ASCII, or EBCDIC. As part of the option, RS-232 external communications and nonvolatile memory are also offered. For service applications, the RS-232 interface allows the analyzers to be remotely controlled via modem, or directly through a smart terminal or controller. The nonvolatile memory is a 2K CMOS RAM that retains three complete instrument setups and one full set of acquisition or reference memory data.

A menu-driven user interface maximizes ease of use and reduces user errors. All necessary parameters for acquisition setup, trigger definition, data display, and external communications are presented in prompt fields on the CRT display. For complex software acquisitions, 3 word recognizers can be linked together in a 3-level sequence.

Although the analyzers cover many applications, they are suited particularly to data communications for testing data links, analyzing protocols, and data checking in local area networks. Model 318 costs $5300; the 338 is $5800. The option, including serial analysis, RS-232 interface, and nonvolatile memory, costs $1200. **Tektronix, Inc, Design Automation Div,** Dept LAA-349, PO Box 1700, Beaverton, OR 97075.

Circle 325

Integrated voice and data terminal implements communication system



With the SL-1 Displayphone from Northern Telecom, authorized personnel have access to computerized information resources and electronic mail systems via video screen and keyboard. This integrated voice and data terminal is specifically designed to combine most of the voice and data features from earlier Displayphones with those of the SL-1 business communications system. The SL-1 can transmit asynchronous data at speeds up to 1200 bps.

Included in the desktop terminal are a 7″ (18-cm) video screen, a retractable keyboard, and a telephone handset for voice communications. Speaker and microphone are for hands-free operation. Conversation can occur while information appears on the screen. Users can store up to 90 names and numbers in an internal directory, view them on the screen, and dial either voice or data calls automatically from the directory. The ring-again feature tells a user when a busy number is free, while the message feature signals the user when a message is waiting.

Simplified data communications is a key feature. Soft keys and prompting easily walk the user through the process. Data calls can be dialed automatically, and the terminal conforms automatically to the task or application required. Computer log-on codes can be stored. Once the Displayphone is connected to a computer, soft function key use can be customized for particular applications. As a data terminal, the unit operates like an asynchronous ASCII terminal, and can be used in almost any application where such terminals are employed.

Two display pages, one for voice and the other for data, are on the screen. Users can select and view either page without altering the contents or disrupting the service performed on the other. Data calls are placed or received on the data line, which provides a fully digital path through the system. Standard 2-pair twisted cable provides connection to the system. Because the data are transmitted digitally, no modems are required within the system. However, modems can be pooled or shared by users over the analog public network for data calls outside the system. The terminal automatically dials the modem pool when required.

A printer port allows connection to a desktop matrix printer, or other printers with industry standard interfaces. An internal battery preserves memory in case of local power failure. Display of date, month, hour, minute, second, and am/pm is provided in the top right-hand corner of the screen. Call timing is automatically provided for calls originated or answered on either line. **Northern Telecom Inc,** 259 Cumberland Bend, Nashville, TN 37228.

See at NCC Booth S5440

Circle 326

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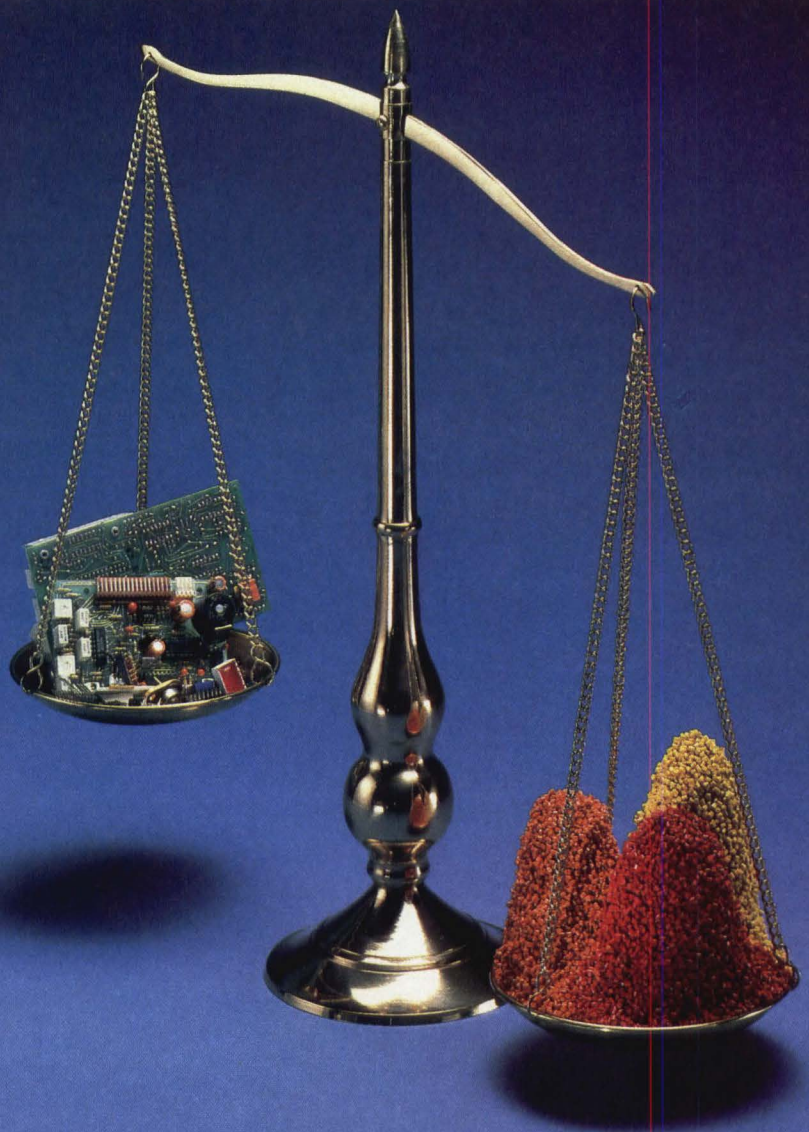
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CIRCLE 149



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CIRCLE 150

64K static RAM board for TM990

The 964M static memory board for TI's TM990 bus has a bus access time of less than 250 ns. Start and end of memory can be set to any 4K-byte boundary on a 64K-byte page. Twenty-bit addressing allows the memory to be located on any 64K-byte page in the bus' 1M-byte addressing range. The board comes without RAM chips or fully populated. The RAMs are pin for pin compatible with TMS 2516 EPROMs. Type 2716 EPROMs can be used in 16K-byte blocks. The board can also be configured as a 128K-byte EPROM board using type 2732 EPROMs. A 64K board is $850. **CIM Co,** 41-A Dorman Ave, San Francisco, CA 94124.

Circle 327

512K-byte LSI-11 RAM board

Offering either 256K or 512K bytes of RAM on a single dual-height, half-quad board, model 18MP features 22-bit addressing, onboard parity generation/checking, and all timing/control logic for the memory. Refresh circuitry operates transparently to the user. Starting address is plug selectable to any 16K boundary. Automatically generated parity bit is logic checked when data are read. Control and status register interrupts and latches the upper address bit location upon error detection and forces bad parity writing for diagnostic purposes. **ADAC Corp,** 70 Tower Office Pk, Woburn, MA 01801.

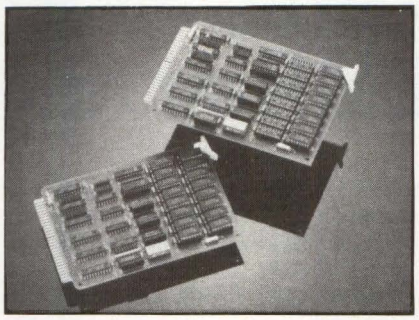
Circle 328

Semiconductor storage systems

Designed for use with Series 1100 large-scale systems, Semiconductor Auxiliary Storage (SAS) and Medium Performance Cache/Disk systems employ dedicated processors and semiconductor storage to hold, transfer, and manage data at high speeds. The SAS configures as either a single- or dual-channel subsystem. One cabinet can handle 917k data words, expandable to 3.6M words; up to 4 cabinets can be connected per system. Data transfer rates reach 5M bytes/s between storage and the I/O processor. The Medium Performance Cache/Disk includes 1 or 2 cache/disk processors and 1 cabinet of semiconductor storage; it can serve as a cache to store data requested from large capacity disk drives. **Sperry Univac**, PO Box 500, Blue Bell, PA 19424.

Circle 329

STD-Z80 bus compatible DRAMs



Designed to simplify implementation of multi-user operating systems, MDX-RAM64 (64K-byte) and MDX-RAM128 (128K-byte) memory cards have a jumper-selectable, bank switched port address to reside at 1 of 256 locations. Bank select structure is compatible with the company's MDX-UMC2, -CPU3, and -CPU4 single-board computers. A memory area common to all banks is allocated to application software or operating systems; optionally, the common area can reside on any board in the system. **Mostek Corp, a sub of United Technologies Corp,** 1215 W. Crosby Rd, Carrollton, TX 75006.

Circle 330

1M-bit bubble memory card

STD Megabubble memory card features 128K-byte secondary storage, onboard file handling, 4K to 16K address space, 48-ms average access time, and system application firmware. It provides 1M-bit memory for STD bus system capability. Operating in poll, interrupt, or DMA mode, card includes interface and support hardware, file maintenance firmware, self-diagnostics, and status indicators. With power supplies of 5 and 12 V, the card provides optional temp ranges of 10 to 50 °C, 0 to 75 °C, or −20 to 85 °C. Prices start at $1195. **Designsmiths, Inc,** PO Box 181, Attleboro Falls, MA 02763.

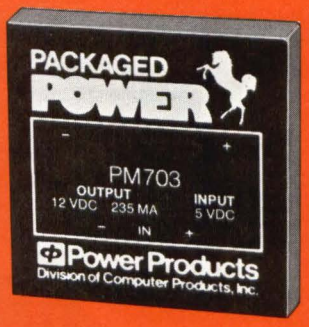
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CIRCLE 151

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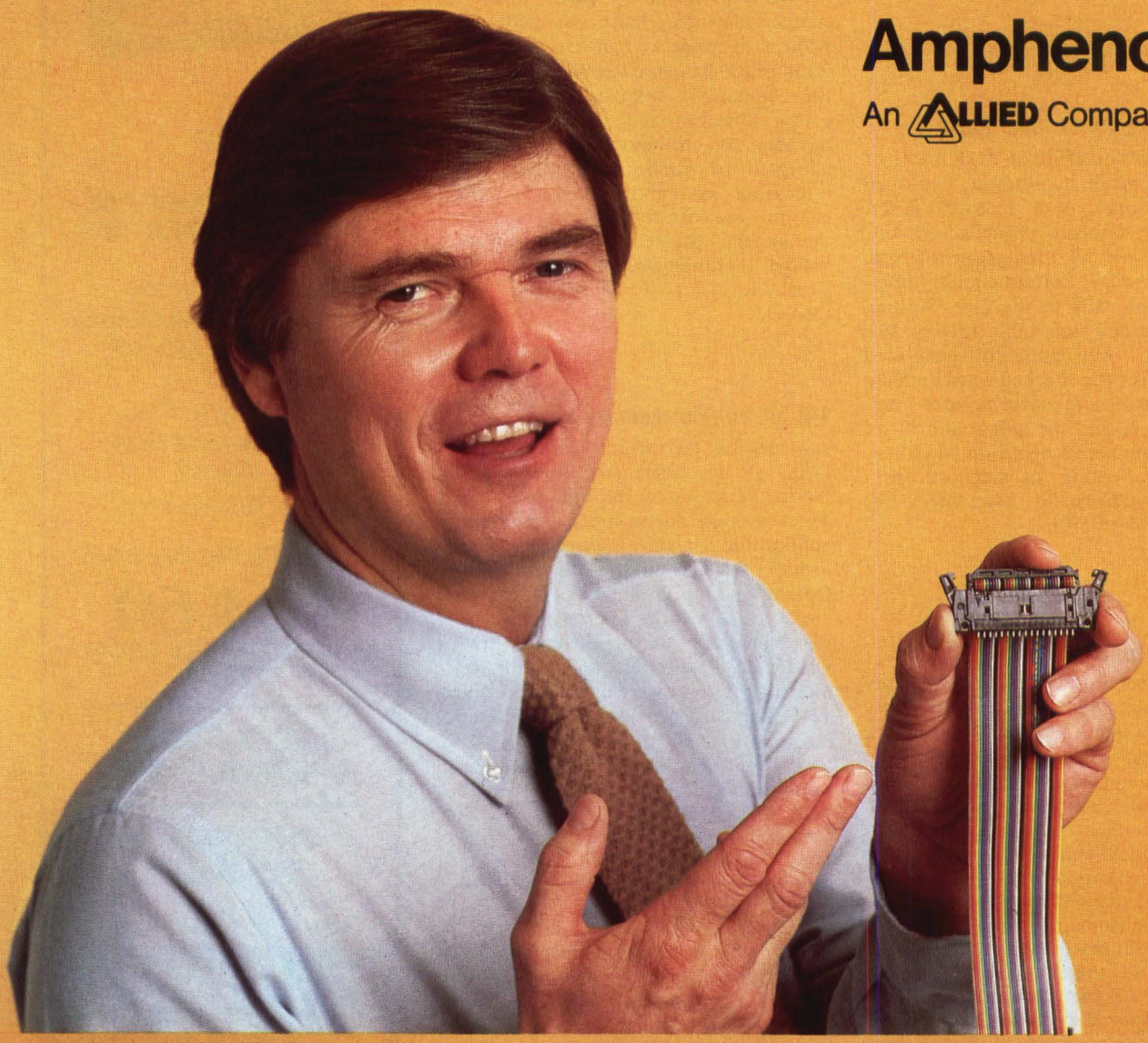
For example, the lock-and-eject feature makes for more secure connects and faster disconnects. And it virtually eliminates stress on disconnects. You can install this feature either during assembly or in the field.

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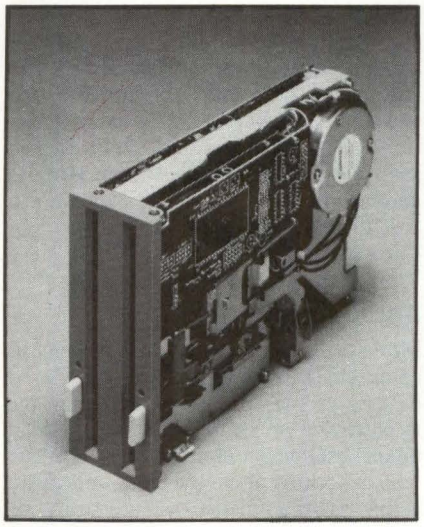
STD bus 256-byte core memory

The CM328 256 x 8 nonvolatile 18-mil core memory for STD bus systems is contained on a single format PCBA. Speed is sufficient to operate with 2.5-MHz CPU without wait states; faster version is planned for 4-MHz CPUs. Op temp range is 0 to 70 °C. Power consumption is 17 W. Power is duty cycle dependent, with standby power of 9 W. Board has internal power fail circuit that shuts down operation if unacceptable drop in operating voltage occurs. Price is $215. **Controlex Corp**, 16005 Sherman Way, Van Nuys, CA 91406.
Circle 332

Low cost 5″ hard disk systems

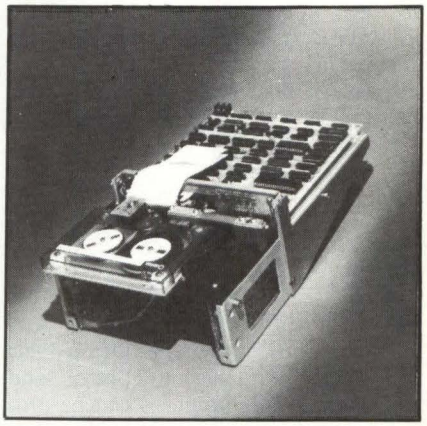
Line of hard disk systems in 5M, 10M-, or 16M-byte formatted configurations includes a 5″ drive, 8″ metal frame with 5- and 12-V regulators, hard disk controller and cable, CP/M 2.2 for Tarbell floppy and hard disk, and documentation. Data transfer rate is 5M bps and average seek time is 120 ms. **Tarbell Electronics**, 950 Dovlen Pl, Carson, CA 90746.
Circle 333

Super thin, high capacity floppies



At 57.5 mm, MDD 422/423 double-density, double-sided floppy disk drives save up to 33% height over 5¼″ drives, while 33.5-mm single-drive model MDD 221 offers an 18% height advantage. The 96-tpi drives have an unformatted capacity of 1M byte/disk; access times are 95 ms max, with 3 ms track to track. In MDD 422, 1 motor drives both disks and 1 stepper motor positions heads for both disks; MDD 423 uses a stepper motor for each drive, enabling the heads to seek independently. **Canon U.S.A., Inc, Peripherals Div**, 1 Canon Plaza, Lake Success, NY 11042.
Circle 334

Fast ¼″ tape system



For high speed Winchester backup, the Streamer model 410 ¼″ streaming tape system operates at 90 ips with a 72k-byte/s max data transfer rate. The cartridge based system stores 45M-byte min formatted data on a std 450′ (137-m) DC300XL cartridge. Designed for 30M-byte and larger Winchester disks, storage increases to 60M bytes when a 600′ (183-m) DC600A cartridge is used. The 410's interface is compatible with the proposed QIC-02 spec. Mounted according to 8″ std disk drives, the system operates from 24 and 5 Vdc, drawing 1 and 3 A, respectively. **Qantex Div, North Atlantic Industries, Inc**, 60 Plant Ave, Hauppauge, NY 11788.
Circle 335

Single-board 2M-byte memory

CI-8086+ memory module for 8- and 16-bit Multibus based microcomputers is available in 128K-, 256K-, 512K-, 2M-, and 1M-byte configurations in a single option slot. The module can generate and check even parity with selectable interrupt on parity error. Dynamic RAM allows max processor throughput via onboard refresh control logic. It is addressable in 32K-, 64K-, or 512K-byte blocks up to 16M bytes. Data access time is 270 ns; cycle time is 400 ns. **Chrislin Industries, Inc, Computer Products Div**, 31352 Via Colinas, Westlake Village, CA 91361.
Circle 336

Winchester drives for IBM PC

Interface series of 5¼" Winchester disk drive subsystems provides up to 15.9M bytes of formatted storage on the IBM PC. Drives are also available with 5.3M- and 10.6M-byte formatted storage. Each subsystem includes software (JEL) for 1.1 DOS. Track density is 345 tpi. Track to track access time is 2 ms with an average access time of 85 ms. MTBF is 10k h at 100% duty cycles. A 512-byte full-sector buffer, 32-bit ECC, and automatic interleaving capabilities are featured. **Interface, Inc,** 7630 Alabama Ave, Canoga Park, CA 91304.
Circle 337

INTERFACE

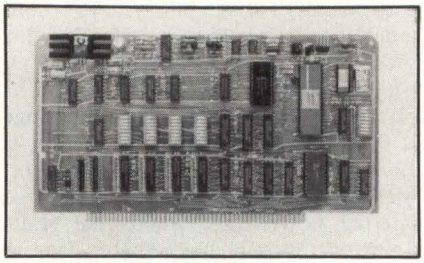
Z80 system controller

Computer power and interfacing logic for building intelligent control and instrumentation equipment can be provided by the Z80 system controller. Features include a 2-MHz, Z80 CPU, 24K bytes of EPROM, up to 16K bytes of RAM, and 24 programmable I/O lines. Two RS-232-C ports have switch-selectable speeds and can be used for protocol conversion and serial interfacing. Onboard software includes a 12K-byte BASIC interpreter with link commands for Z80 assembly routines and a floating point math package suited to instrumentation applications. Clip-on PROM programmer enables programs developed in RAM to be stored in EPROM. **Vertec Ltd (Electronics),** Maxwell Bldg, 43 The Crescent, Salford, Manchester M5 4WT, England.
Circle 338

CP/M board for PDP-11 and VAX

The UCP-11 8/16-bit board plugs into the back of a VAX or PDP-11 computer to create CP/M workstations capable of interacting with DEC peripherals. Coprocessor board operates in parallel with the DEC processor, without degrading performance. The PDP-11 or VAX is called only to perform CP/M requested I/O. UCP-11 can be activated from any terminal already attached to a DEC mini-network. It is available under RT, TSX-Plus, and RSX-11 M-Plus; RSTS and UNIX availability is planned. Baud rates from 75 to 19.2k are supported; controller provides PDP-11 bus interface logic for high speed data transfers. **Alloy Computer Products,** 12 Mercer Rd, Natick, MA 01760.
Circle 339

IEEE 696 and ARCNET interface



ARCS100 LAN controller module provides a simplified interface between the S-100 bus and Datapoint's ARCNET modified token-passing LAN. Board also provides complete control for user transparent network operation. A 2K onboard data packet buffer for 4-page packet storage is included. Onboard 8253 programmable interval timer simplifies the software interface with user programmable time-outs. ARCS100 can support up to 255 nodes/network segment (running at 2.5M baud) and can be polled or interrupt driven. Price is $535. **Standard Microsystems Corp,** 35 Marcus Blvd, Hauppauge, NY 11788.
Circle 340

Model III disk controller board

The DX-3D fully assembled and tested floppy disk controller for the TRS-80 configures for any combination of 5¼" and 8" drives. The DX-3DC adds realtime clock and calendar. Clock/calendar is fully user programmable and operates by onboard lithium battery. DX-3D uses gold edge connectors, fully buffered address and data lines, and LSI data separation. An advanced digital phase locked loop circuit guards against drift. **Holmes Engineering Inc,** 3555 S 3200 West, Salt Lake City, UT 84119.
Circle 341

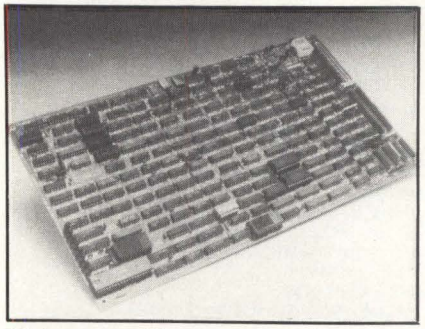
STD bus/IEE 488 interface

Model ST4311 allows STD bus systems to communicate over the IEEE 488 bus. Based on TI's TMS9914 processor, the interface is software programmable for IEEE 488 talker, listener, or controller modes. The board permits IEEE 488 communication using programmed-I/O, interrupt, or DMA techniques; an onboard LED array shows the state of IEEE 488 control and status lines. Each ST4311 comes with a CP/M compatible, diskette-based driver program in source and .COM formats. Single-quantity price is $350. **Applied Micro Technology, Inc,** PO Box 3042, Tucson, AZ 85702.
Circle 342

Disk controllers link to PDP-11s

Three disk controllers provide system integration of 8" Fujitsu or similar Winchester drives in PDP-11/24 through PDP-11/70 minicomputer systems. Controllers and drives emulate RM02, RM03, and RM03 systems. Controller DU218-5 interfaces PDP-11s with up to 4 Fujitsu 2312 Winchesters. Formatted storage capacity is 268M bytes. DU218-4 accommodates up to four 330M-byte drives that appear to the PDP-11 as RM05s. DU218-3 mates PDP-11s with 1 or 2 165M- or 160M-byte drives. All series controllers ($2990 each) interface directly to the Unibus and are diagnostic and software transparent to RSTS-E or RSX-11M operating systems. **Distributed Logic Corp,** 12800 Garden Grove Blvd, Garden Grove, CA 92643.
Circle 343

Tape/disk controller



Without special I/O control software, an intelligent controller links the D160 24-track, 160M-byte ½" streaming tape drive to a host processor and to 2 SMD compatible Winchester disk drives. The single-board C163 controller supports 1.2M-byte/s transfer rates at 8 MHz across a SASI or SCSI bus. It also handles offline nonstop streaming file backup/restore at 90- or 130-ips tape speed. Features include 2 integral data separators for tape and disk, as well as onboard error correction and control. **Rosscomp,** 16643 Valley View Ave, Cerritos, CA 90701.
Circle 344

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Conventional monitor pixel



Hitachi DDC monitor pixel



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CONVERGENCE CHART

	Hitachi Monitor with DDC	Conventional Monitor
Quality Circle	0.1mm	0.5mm
Full Screen	0.3mm	1.0mm

HITACHI

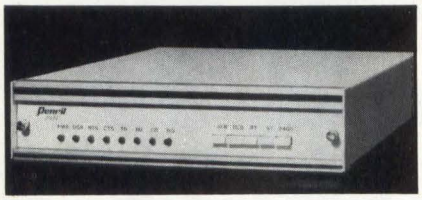
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CIRCLE 154

Low cost 4800-bps LSI modem



Model 2027 LSI modem meets CCITT V.27 bis. Operating at 4800 or 2400 bps, it can be used on 2- or 4-wire leased lines in point to point or multipoint applications. Standalone model has a single-quantity price of $1595; rackmount and single-card OEM versions are available. Low error rate is achieved on both domestic and European lines via automatic adaptive equalizer, which adjusts for variations in line properties. Automatic corrections are made for amplitude and envelope variations. Standalone model measures 10.5″ x 2.38″ x 13.25″ (26.7 x 6.05 x 33.66 cm). **Penril Corp,** 5520 Randolph Rd, Rockville, MD 20852.

Circle 345

Async/sync data channel units

Digital multiplexer TDM-150 uses asynchronous data modules DA-191 and DA-192 and synchronous modules DS-562, DS-256, and DS-512 for data rates to 512k bps. The DA-191 and DA-192 interface with RS-232-C and RS-449; the DS-562, DS-256, and DS-512 interface with RS-449. Full- or half-duplex communication is provided. Modules plug into any channel location and configure for any T1 direction and time slot. **Tau-tron Inc, a unit of General Signal,** 27 Industrial Ave, Chelmsford, MA 01824.

Circle 346

Integral 1200-baud modem

A Bell 212 compatible modem for the IBM PC communicates at 300 or 1200 bps. The PC:IntelliModem features a telephone handset jack for programmatic switching between voice and data communications without redialing. Capabilities include auto-dial/answer and auto repeat/dial. Menu-driven software provides complete terminal emulation. Repertory dialer function stores frequently dialed numbers that can be accessed with a single keystroke. Over 50 commands and status checks are provided. Domestic list price is $499. **Bizcomp Corp,** PO Box 7498, Menlo Park, CA 94025.

Circle 347

Fast synchronous switcher

Model 9005 Dataswitch synchronous intelligent switching system accommodates up to 256 subscribers with 24M-bps communication speed. Fallback switching ensures system continuity in a 2-computer network when 1 computer fails. Data line monitoring feature monitors all data in the system. Prioritized queuing, automatic record keeping, system security passwords, and automatic recording of all system statistics and background diagnostics are standard. An optional automatic common logic switchover monitors all active system polling and clocking. **Develcon Electronics Inc,** 4037 Swamp Rd, Doylestown, PA 18901.

Circle 348

Network data encryptor



Dial-up Datacryptor II safeguards data on circuit switched networks. It operates half- or full-duplex, sync or async, at up to 9.6k bps. The encryptor can create and downline load session keys for each modem connection, then erase the key at both ends of the link when modems disconnect. Std features serve networks designed to accommodate unlimited numbers of terminals and support multiple encryptors on a rotary. Three models are available: the 3400 central unit and the 3500 and 3600 remotes. **Racal-Milgo,** 8600 NW 41st St, PO Box 520399, Miami, FL 33152.

Circle 349

June Preview—
Watch for a major staff-written review on nonvolatile semiconductor memories.

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Ball point pen writing, for alpha-numerics and graphics. Exclusive ink technology developed by Alps makes possible the use of specially engineered, tiny ball point pens that actually *write*, in 1 or 4-colors, with a simultaneous plotter action in the X and Y-axes. Virtually unlimited capability for character size variations, special symbols, images, even 3-D graphics.

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2¼" or 4½" plain paper. All DPG mechanisms use standard commercially available plain paper: 2¼" for Models DPG 11 or 13 (1 or 4-color); 4½" for Models DPG 21 or 23 (1 or 4-color).

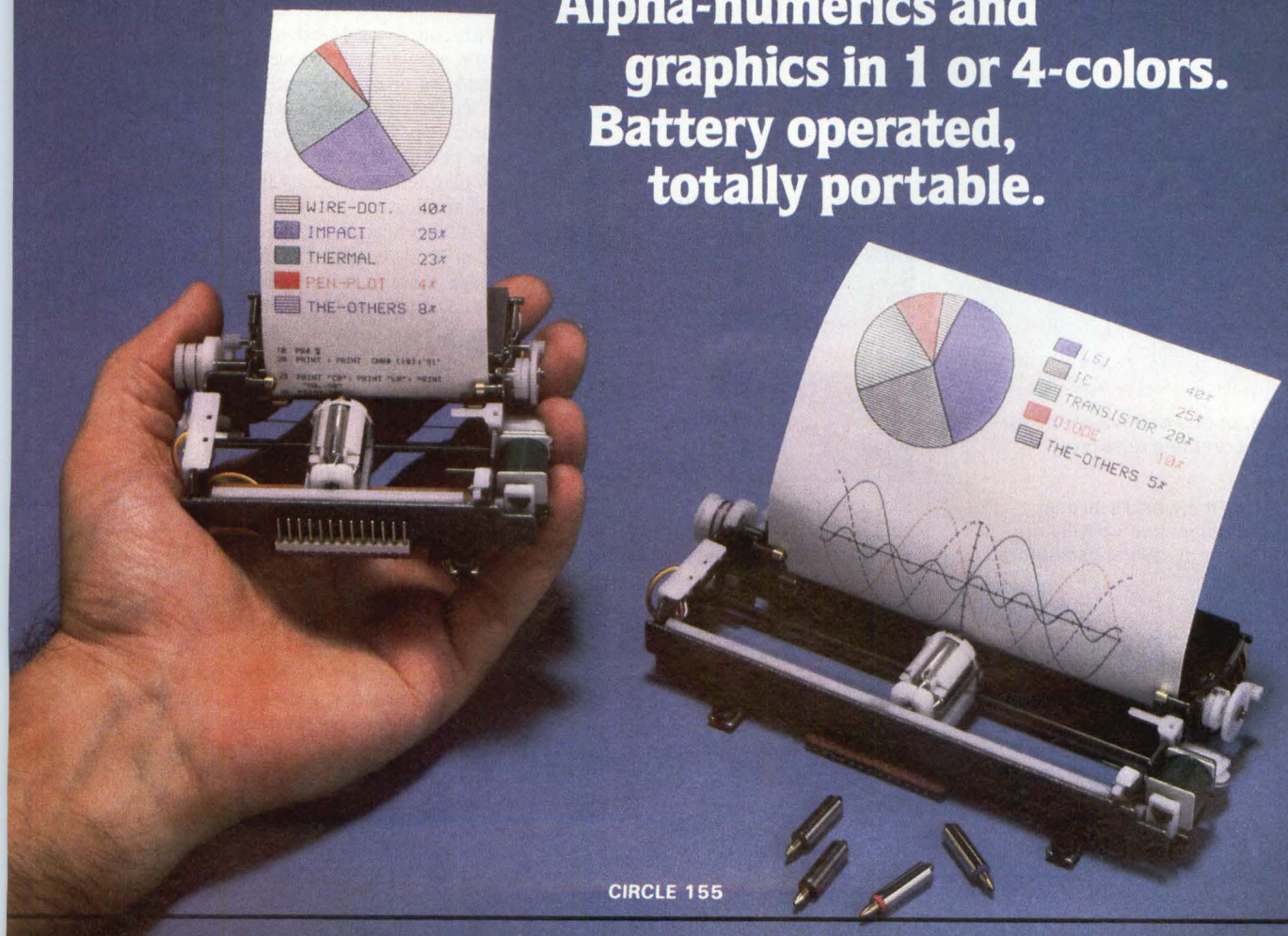
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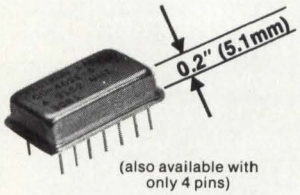
Alpha-numerics and graphics in 1 or 4-colors. Battery operated, totally portable.



CIRCLE 155

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TTL per MIL-0-55310/16
CMOS per MIL-0-55310/18



(also available with only 4 pins)

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- **CMOS: 1 Hz-15 MHz**
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- **Ruggedized for Severe Environment**

	CO-402 Series	CO-412 Series
Output:	TTL	CMOS
Input:	5 VDC	8-15 VDC (5 V opt)
Frequency:	16 KHz-100 MHz	1 Hz-15 MHz
Accuracy (25°):	4 options: ± 50 ppm, ± 25 ppm, ±15 ppm or settable to 1 ppm via external capacitor	
Stability:	Std: ±25 ppm over 0°C/+ 70°C Opt: ± 5 ppm over 0°C/+ 50°C Opt: ±50 ppm over −55°C/+125°C	
Size:	0.5" x 0.8" x 0.2"	

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CIRCLE 156

International 4800-bps modem

NCM4800V network control and management modem is compatible with CCITT V.27 bis and a 22.4-ms fast train environment. It operates on 4-wire unconditioned M1040 or 3002 leased lines and is type-approved by British Telecom. Data training, self-testing, and V.27 compatible scrambling are std. Diagnostic and restoral capabilities independent of main data and without remote intervention are provided. Communication over PSTN or DDD networks is possible if leased line fails. **Intertel,** 6 Shattuck Rd, Andover, MA 01810.
Circle 350

Ethernet interface to DG minis

The N14010A controller board interfaces Data General's Nova, Eclipse, and 32-bit Eclipse/MV minicomputers to the Ethernet LAN. The controller complies with IEEE-802.3 and ECMA 80/81/82 specs for 10M-bps CSMA/CD networks. On transmission, it formats frames and performs collision detection, backoff timing, and retransmission to the LAN. Up to 13.5k bytes of received frames can be stored to protect from receiver overruns. Power-up self-tests, pass/fail LED indicator, and loopback/transceiver diagnostics are included. **Interlan, Inc,** 3 Lyberty Way, Westford, MA 01886.
Circle 351

Synchronous modem



SNA compatible 7160 modem series includes the 7164-0100 4800-bps model that provides network diagnostics automatically initiated by a host or controlled by the operator. The microprocessor based modem uses mainstream diagnostics. Fully synchronous, it operates over voice grade leased lines transmitting in full-duplex mode over a 4-wire circuit. It adheres to CCITT recommendations V.27, V.26, and V.29, as well as RS-232, V.24, and V.28. Priced competitively with nondiagnostic modems, the unit will be available in June. **NCR Comten, Inc,** 2700 Snelling Ave N, St Paul, MN 55113.
Circle 352

Time-division multiplexers

Series 2211 TDMs minimizes communications-line costs by concentrating data from up to 96 channels for transmission over a single, 2.048M-bps trunk facility. The microprocessor based design provides network management and monitoring capabilities that permit online reconfiguration, alarm monitoring, and system diagnostics. The ability to multiplex different synchronous and asynchronous data types from a variety of information resources brings the economic benefits of high bandwidth circuits to private communications users. **Amdahl Corp,** PO Box 470, Sunnyvale, CA 94086.
Circle 353

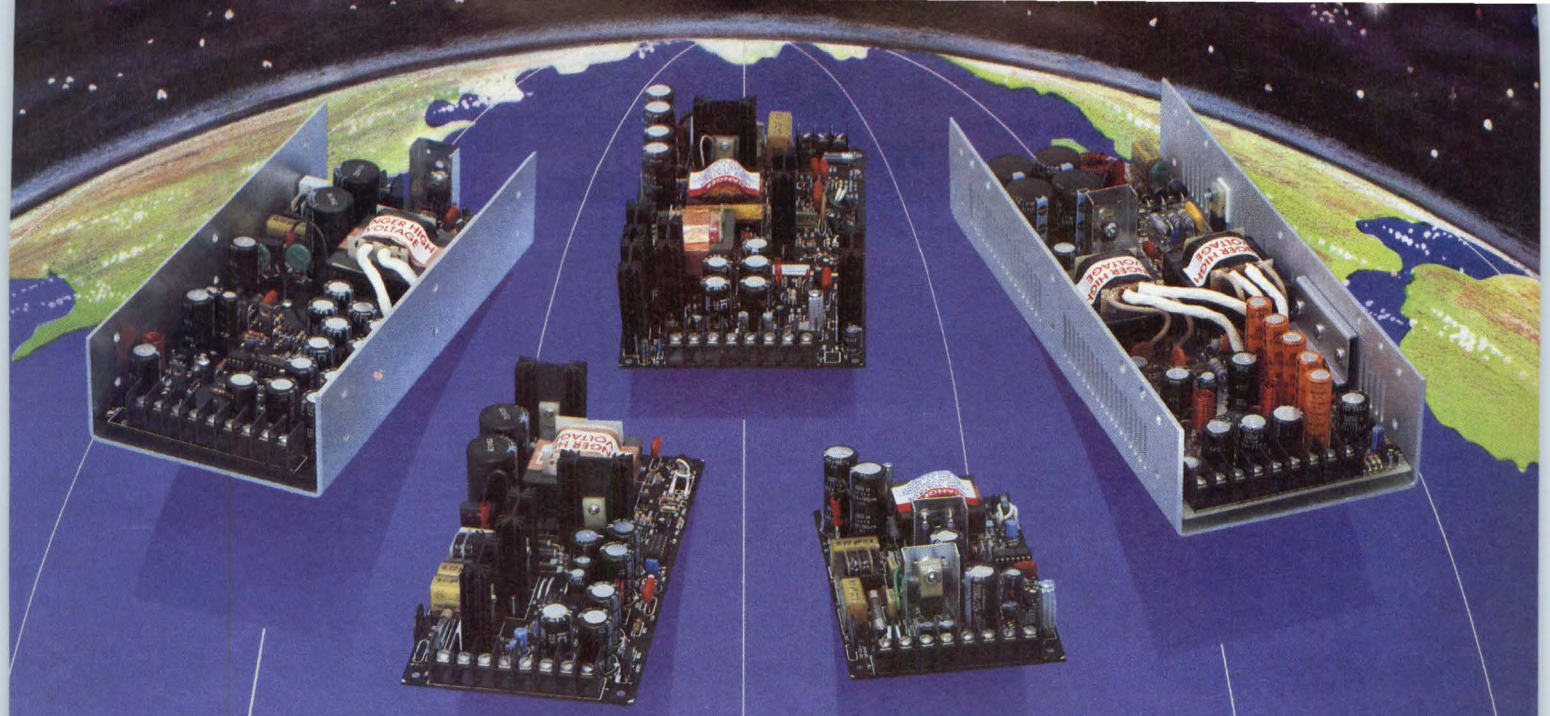
SOFTWARE

Enhanced database system broadens scope

Informa x information management system, written in Pascal, features cross-file data sharing, multiple file reporting, and multiple screens/record. System runs on 8- or 16-bit machines with Z80, 8085, 8086, and 8088 processors and CP/M-80 and -86 operating systems, or on multi-user systems using TurboDOS, Mmmost, and dpc/OS. In addition, MS-DOS, PC-DOS, N-Star, and MP/M compatibility is planned. A virtually unlimited number of application files can be created and a multikey search completed in under 25 s. Ten-level password system protects data base. **Abacus Data, Inc,** 1920 San Marco Blvd, Jacksonville, FL 32207.
Circle 354

Multi-user system LAN package

NET 8-16 LAN software package links MP/M 86® or MP/M® 8-16 based CompuPro system 816 computers while supporting simultaneous 8- and 16-bit program operation. Allowing multi-user systems to support CP/M application programs within a LAN, the software provides up to 64 terminals with record locking, password protection, time stamping, automatic backup, queues, and multitasking commands. Network controller and proprietary software permit 1 or more "requester" systems to be linked by coaxial cables to "server" systems. Base price with 2 controller boards and software is $1995. **Gifford Computer Systems,** 1922 Republic Ave, San Leandro, CA 94577.
Circle 355



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SPL53-4000	8A	2.5A/5A PK	0.6A	0.6A					
SPL53-4101	8A	1.2A	0.6A		1.5A/3A PK		80W cont.	2.10 x 4.25 x 8.25	$125
SPL53-4102	8A	1.2A	0.6A			2.5A/5A PK			
SPL65-5000	8A	1.2A	1.2A	0.5A	1.2A/1.5A PK		85W cont. 95W PK	2.10 x 5.00 x 9.00	$150
SPL130-4100	15A	4A/6A PK	1.5A			1.5A			
SPL130-4101	15A	1.5A	1.5A		2A/4A PK		130W cont. 150W PK	2.45 x 5.00 x 10.50	$198
SPL130-4102	15A	4A/6A PK	1.5A	1.5A					
SPL200-4100	35A	4A/8A PK	1.5A	1.5A					
SPL200-5100	35A	4A/8A PK	1.5A	1.5A		1.5A	200W cont. 250W PK	2.45 x 5.00 x 13.00	$270
SPL200-5200	35A	4A/8A PK	1.5A	1.5A	4A/6A PK				

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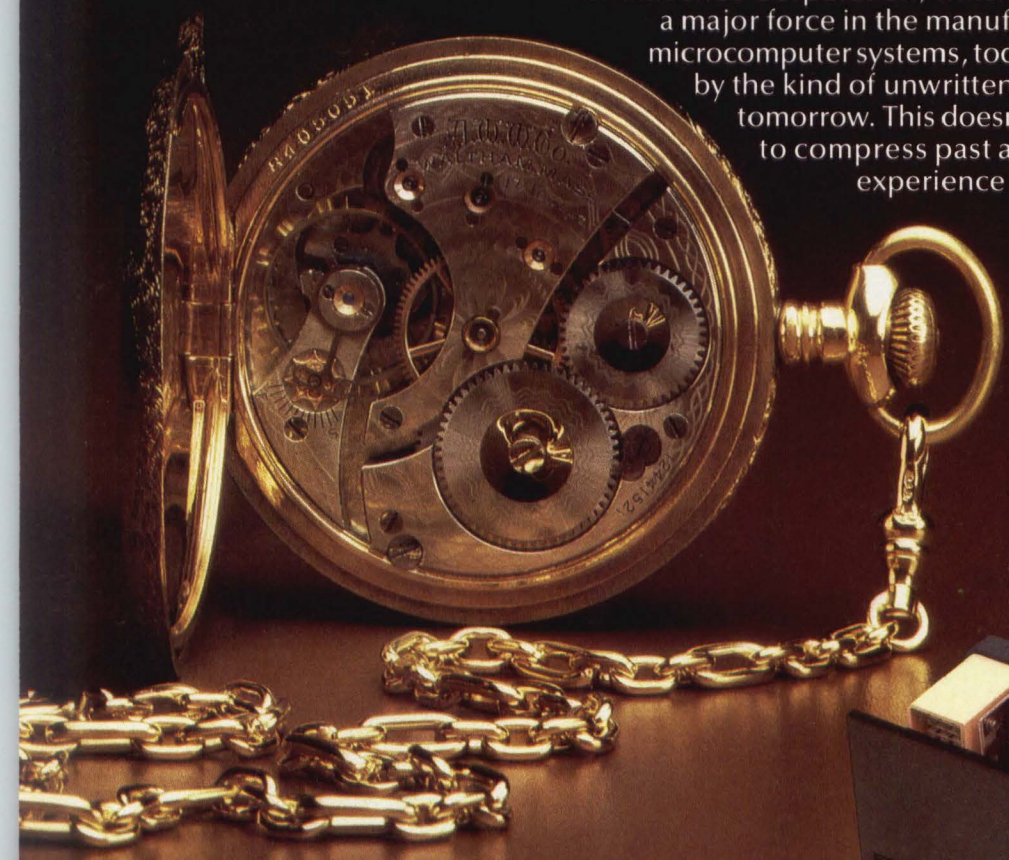
CIRCLE 157

Some Standards Are Untouched by Time

Standards of excellence and integrity are discovered and verified only from experience. These are qualities to be earned over time and, perhaps, that is why we most often look to the past to assign such values to a company or its products.

At MiniScribe Corporation, which, in less than two years, has become a major force in the manufacture of Winchester disk drives for microcomputer systems, today's business practices are motivated by the kind of unwritten standards that will be remembered tomorrow. This doesn't bypass the test of time, but it tends to compress past and future into a rewarding present experience for customers and employees alike.

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The MII, 5¼" rigid disk drive with 6.4 or 12.8 megabytes of storage, very contemporary and noted for precision performance and high reliability. From the MiniScribe collection.

MiniScribe

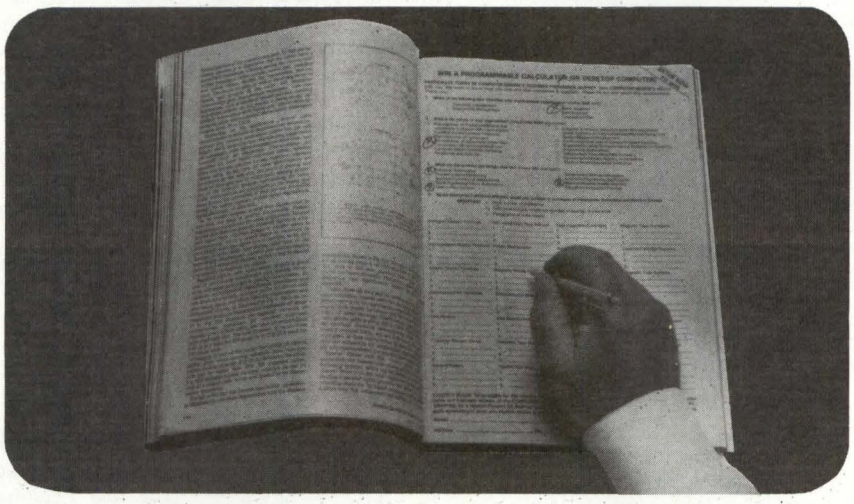
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CIRCLE 158

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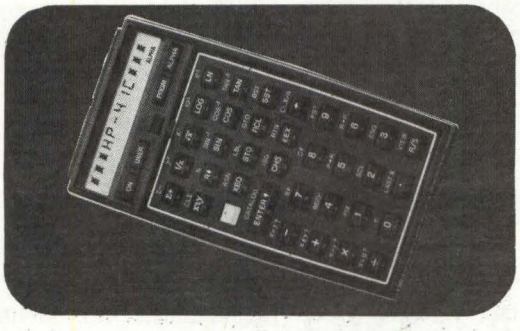


In every issue of *Computer Design* you'll find a bound-in survey questionnaire entitled "Designer Preference Survey." Your participation in these surveys is important. Your answers are significant. They tell our editors what's going on in the marketplace, what kinds of systems you are designing, how your product choices are shaping up, what products, subsystems, equipment and components you are using or would like to use.

The answers you supply can guide our editors in selecting the topics, features, and technical data that will be on target with the kinds of projects you are working on.

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MONTHLY DRAWING

HP 41C

PROGRAMMABLE CALCULATOR

The HP 41C offers advanced problem-solving power yet is easy to use. Communicates in words as well as numbers. Can be programmed to meet your specific needs. Fifty-eight popular functions, 130 total operations in function library. You can add peripherals and extension modules to expand capabilities.



ANNUAL DRAWING

HP 85

DESK TOP COMPUTER

This portable (20#) unit includes an alphanumeric keyboard, tape drive, thermal printer, built-in 56 K byte memory, CRT screen, and 150 built-in HP BASIC language commands. You can add peripherals and software packages to expand system capability. A $2800 value!

COMPUTER DESIGN

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The only design magazine that concentrates on computers.

Interface to IBM mainframes

CT-SNA software allows Convergent's distributed intelligence desktop workstations (16 max) to communicate with IBM mainframes using SNA. The software includes SNA gateway for low level communications between the workstation cluster and IBM mainframe. The SNA/3270 emulator supports high level presentation services from workstation to mainframe via SNA gateway. The SNA/3270 provides PU.T2 (3276) functionality with LU.T2 (3278) and LU.T3 (3278) support. The SNA/RJE package (which will be available later this year) allows files to be transmitted between a workstation cluster and mainframe. The SNA/3270 emulator, bundled with SNA gateway, is $40,000 for multi-use OEM license, or $2000 for single copy. **Convergent Technologies,** 2500 Augustine Dr, Santa Clara, CA 95051.
Circle 356

MS-DOS version 2.0

Version 2.0 of the MS-DOS operating system for 8086 and 8088 microcomputer based systems takes up 20K of memory and features hierarchical filing structures, installable device drivers, and redirection of I/O for greater XENIX compatibility. Also compatible with the earlier 1.0 version, MS-DOS 2.0 allows a manufacturer to install a new device driver when integrating a peripheral. The OS treats the peripheral as a file that, once named, can be opened, used, and closed similar to any other file. Redirection of I/O allows the user to alter data flow from 1 device in the system to any other device or file. Microsoft is shipping the MS-DOS 2.0 update to OEMs using version 1.0. **Microsoft Corp,** 10700 Northup Way, Bellevue, WA 98004.
Circle 357

Color graphics software

Designed to run on any microprocessor or minicomputer, the Cadregraphics-II color graphics software package can generate complete color pictures in 1 to 2 s typ. Features include high level graphics language processor, conversational picture generator, plotting module, runtime library, and terminal handler. Limit checking for high/low warnings and alarms, archival record, trending module, and additional symbol library for business graphics applications are optional. **The Cadre Corp,** PO Box 47837, Atlanta, GA 30362.
Circle 358

UNIX for 68000 based processor

Single- and multi-user System III UNIX for the IS-68K, a 68000 based LSI-11 bus compatible processor, have System III utilities plus 35 Berkeley utilities (including visual editor). A quad-size processor card with 256K bytes of dual-ported, parity-protected memory, the 10-MHz version accesses memory with no wait states. Onboard local bus allows memory expansion to 4M bytes. Memory management system supports demand paging and DMA on the LSI-11 bus. Speed is comparable to the DEC VAX 11/750 in computational power and superior to the VAX in UNIX performance. **Integrated Solutions, Inc,** 1350 Dell Ave, Campbell, CA 95008.
Circle 359

Digital logic simulator

Aimed at design verification and test generation for complex ICs, the CADAT (computer aided design and test) digital logic simulator is written in the C language and runs on a DEC VAX computer under the VMS. Operation under UNIX and Primos operating system is planned for later this year. By combining design and fault simulation capabilities, CADAT provides simulation support for a new chip from its initial design stages through generation of a manufacturing test procedure. Twelve-state simulation accurately models the behavior of both bipolar and MOS technologies. Timing resolution is 10 ps. **Softron, Inc,** 116 Rte 17 N, Upper Saddle River, NJ 07458.
Circle 360

8- to 16-bit software upgrades

"Toolbox" software package for fast integration of existing 8-bit software onto 16-bit computers includes diagnostic/conversion utilities, Screenplot screen graphics handler, and Screenwright screen format generator. A third module, the Sourcerer, includes a family of intelligent disassembler programs for custom designed system software. TRX file transfer package allows data transfer between 2 CP/M-86 microcomputers that are linked directly by RS-232 or modems. The package works with both CRM and MS-DOS machines, and is $595 complete with manual and floppy disk. **Export Software International,** 4 Canongate Venture, New St, Royal Mile, Edinburgh, EH8 8BH, United Kingdom.
Circle 361

IBM PC graphics software

A 2-part graphics software package for the IBM Personal Computer includes a device driver for a mainframe, mini, or 32-bit micro host computer with TELL-A-GRAF® or DISSPLA® graphics software and a floppy disk graphics link. Software maintains machine independence for computer interface to Apollo, Burroughs, CDC, Cray, DEC, Honeywell, IBM, Perkin-Elmer, Prime, and Univac computers. Slide projector stores completed graphics. Host computer device driver is $2000 and encoded floppy disk, $245. **Integrated Software Systems Corp,** 10505 Sorrento Valley Rd, San Diego, CA 92121.
Circle 362

INTEGRATED CIRCUITS

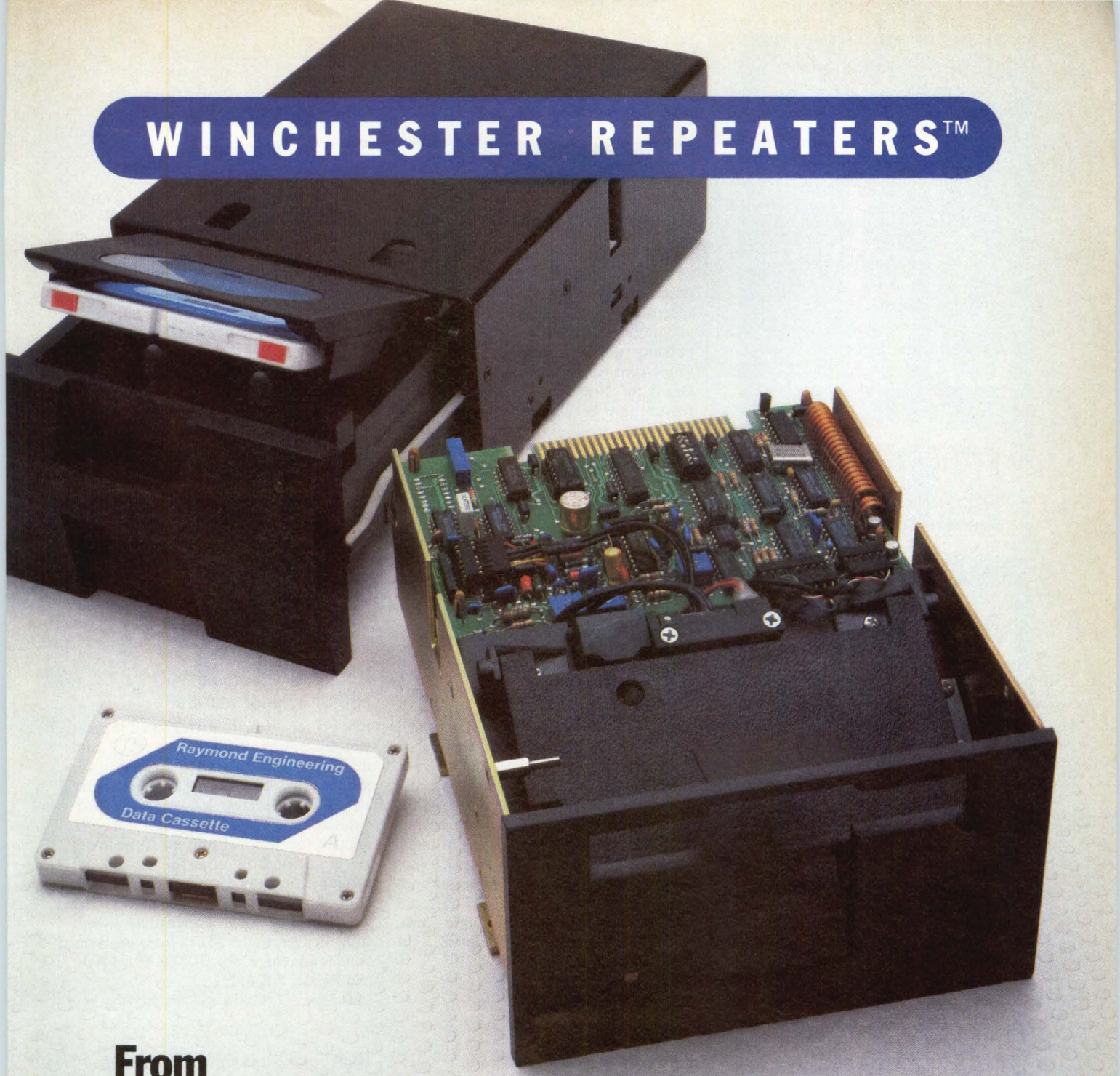
ISL gate arrays

A family of integrated Schottky logic (ISL) gate arrays includes 5 array densities ranging from 836 gates with 48 I/Os to 2376 gates with 84 I/Os. All arrays have interdensity cell compatibility and topological uniformity for universal macrofunction and I/O designs. Typ gate propagation delay is 2.3 ns. A 1.8-ns version is available by selective hook up of collector pull-up resistors on each ISL gate. Power dissipation is 350 μW/gate, yielding a speed power product of 0.8 pJ. The TTL compatible, high radiation tolerance arrays have −55 to 125 °C op temp range. **Raytheon Semiconductor Div,** 350 Ellis St, Mountain View, CA 94040.
Circle 363

FIFO RAMs

Direct replacements for Monolithic Memories' 67401 devices, DM77S401/87S401 and DM77S402/87S402 FIFO RAMS are organized in 64-word by 4-bit and 64-word by 5-bit structures, respectively. The chips' 10-MHz data rate allows use in high speed disk and tape controllers as well as in communication buffers. Features include TTL compatible inputs and outputs and a choice of synchronous or asynchronous operation. The chips are housed in 16-pin DIPs and are pin compatible with Fairchild's F3341 MOS devices. Prices start at $19.50 each in quantities of 100. **National Semiconductor,** 2900 Semiconductor Dr, Santa Clara, CA 95051.
Circle 364

WINCHESTER REPEATERS™



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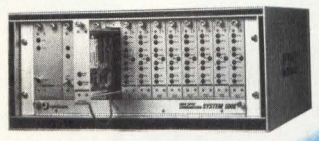
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CIRCLE 161

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CIRCLE 162

3K-gate, 80-MHz logic arrays

R series uncommitted logic arrays (ULAs) satisfy system requirements for 500 to 3k gates at frequencies up to 80 MHz with min system power levels. Consisting of 32 gate arrays, series has 8 gate complexities in 3 speed/power combinations ranging from CMOS power levels to ECL speeds. Each ULA has an array of uncommitted active and passive components fully processed, except for final single-layer aluminum interconnection. Based on 3-micron technology, arrays feature an emitter-follower buffered CML gate structure with independent output that provides a wired-OR facility. Gate structure provides propagation delays to 1 ns, delays independent of fanout, and a 30% savings in gate usage and corresponding decrease in gate chain delays. Development charges start at $10,000 at the 500-gate level. **Ferranti Semiconductors,** 87 Modular Ave, Commack, NY 11725.

Circle 365

Second generation HCMOS logic arrays

LL7000 series of HCMOS logic arrays have 10k gate counts and propagation delays of 1.3 ns through a 2-input NAND gate. Gate lengths are 2 microns drawn, 1.4 microns effective. The thin gate-oxide, self-aligned, scaled, poly-silicon devices are interconnected with 2 levels of metal (equivalent to technology of 64K CMOS static RAM fabrication). The series span gate counts from 968 to 10,013 and max I/Os from 54 to 202. **LSI Logic Corp,** 1601 McCarthy Blvd, Milpitas, CA 95051.

Circle 366

CMOS 4″ wafer 8-bit microprocessors

ISO-CMOS 4″ (10-cm) wafer process versions of the 6500 8-bit microprocessor include 18 separately configured devices comprising 2 series. Series G65SCXX is pin to pin compatible with NMOS product versions. G65SC1XX series includes several hardware/software enchancements including an onboard divide by 4 oscillator, memory lock output, and bus enable input. All microprocessors are intra-family software compatible and all are bus compatible with MC68000 products. CMOS peripheral support includes parallel interface adapter, interface adapter with 16-bit timer, RAM I/O timer, and asynch interface adapter. **GTE, Microcircuits Div,** 2000 W 14th St, Tempe, AZ 85281.

Circle 367

Sync mode avionic receiver/transmitter

COM 1553B synchronous mode avionic receiver/transmitter (SMART) 40-pin COPLAMOS®n-channel MOS/VLSI circuit simplifies interface of a 16-bit microprocessor or buffer to the serial MIL-STD-1553B data bus. Device has a double-buffered serial to parallel, parallel to serial converter, Manchester encoder/decoder, response timer, protocol sequencer, error detection logic, and DMA controller onchip. Serial Manchester II biphase encoded data are received from a 1553B bus receiver and converted to 16-bit parallel data. When receiving Manchester data, COM 1553B detects/identifies sync polarity, reconstructs the clock, detects zero crossing, checks for proper number of bits, and performs a parity check on incoming data. **Standard Microsystems Corp,** 35 Marcus Blvd, Hauppauge, NY 11788.

Circle 368

Monolithic IC drives 200-W stepper motors

L298 power linear IC drives small bipolar stepper motors from up to 50 V and delivers up to 4 A of total current to the motor. Circuit includes 4 push-pull drive stages for inductive loads. Device provides all of the power interface from TTL logic to the motor. Emitters of the lower stages of the 2 internal full bridges are available for external current sensing for constant current drive applications. The device can be easily attached to a heat sink. Price is under $5/1k lots. **SGS-ATES Semiconductor Corp,** 7070 E Third Ave, Scottsdale, AZ 85251.

Circle 369

High speed monolithic S/H amp

SHM-20 features an internal 100-pF MOS hold capacitor. Acquisition time is typ 1 μs for a 10-V step to 0.01% with a typ aperture uncertainty of 1 ns. Unit includes an input transconductance amp, low leakage analog switch, and output integrating amp. For improved droop rate, an external hold capacitor can be added. Pedestal voltage can be adjusted to 0 via external offset adjust trimpot. A 30-ns aperture delay time, 1-mV pedestal error, min dc gain of 10 V/V, and full differential input with a ±10-V input voltage range are also featured. Max input offset voltage is as low as 0.5 mV with a max input offset voltage drift of 15 μV/°C. **Datel-Intersil,** 11 Cabot Blvd, Mansfield, MA 02048.

Circle 370

16K-bit ECL RAMs

MBM10480 and MBM100480 ECL RAMs offer 15-ns access times in a 16K- x 1-bit configuration. Suited to main-memory, buffer, and control applications, the devices feature onchip voltage/temperature compensation to improve noise margins. An active pullup technique makes use of an active lateral-structure pnp load cell to maintain a constant internal voltage during transitions from small standby currents to large read currents; this scheme permits a 20- x 37.5-μm cell size. (Die size is 6.07 x 3.53 mm.) Power dissipation equals 0.04 mW/bit. Units are housed in 20-pin cerDIP packages. **Fujitsu Microelectronics,** 3320 Scott Blvd, Santa Clara, CA 95051.
Circle 371

High speed 12-bit DAC

The MC3412/3512 DAC employs monolithic bipolar and thin-film resistor technology to achieve 12-bit resolution. Active laser trimming at wafer level keeps gain and offset error limits to $\pm 0.25\%$ and $\pm 0.05\%$ FSR, respectively, without external adjustment. Integral nonlinearity is set to $\pm \frac{1}{2}$ LSB, and settling time to $\frac{1}{2}$ LSB at 400 ns max. Unit incorporates an internal precision 10-V bandgap reference and span/bipolar offset resistors. Output voltage ranges include 0 to 5 V and 0 to 10 V. A threshold-control pin permits selection of CMOS or TTL logic levels at data inputs. **Motorola Semiconductor Products, Inc,** PO Box 20912, Phoenix, AZ 85036.
Circle 372

High speed 64 x 9 FIFO memory

A 15-MHz data rate equips TDC1030J6 for applications in video time base corrections, A-D output buffers, I/O formatting for digital filters and FFTs, disk/tape certifications, and voice synthesizers. With TTL compatibility and a fallthrough time under 2 μs, the unit operates from a single 5-V power supply. Max power dissipation is 1.5 W. Memory stores 64 words by 9 bits in a 28-pin DIP, and can expand in both word and bit dimensions. Control signals include shift in, shift out, master reset, and 3-state output enable. **TRW LSI Products Div, Electronic Components Group,** PO Box 2472, La Jolla, CA 92038.
Circle 373

4K x 4 CMOS static RAMs

IDT6168 and IDT71681 4K x 4 CMOS static RAMs feature mil speeds 20% faster than NMOS devices while typically consuming 225 mW from a 5-V supply. Guaranteed over the -55 to 125 °C temp range, 55-, 70-, 85-, and 100-ns speeds are available. All versions are screened to MIL-STD-883 class C. Mil grade versions are screened to full class B requirements. Both 16K devices also feature commercial access and cycle times from 45 to 85 ns max. Standard and low power options are provided. Packaging options include IDT6168 in a JEDEC std 20-pin DIP or 20-pin LCC with common data I/Os. IDT71681 has separate data I/O lines and is in a 28-pin LCC or 24-pin, 300-mil wide thinDIP package. **Integrated Device Technology, Inc,** 3236 Scott Blvd, Santa Clara, CA 95051.
Circle 374

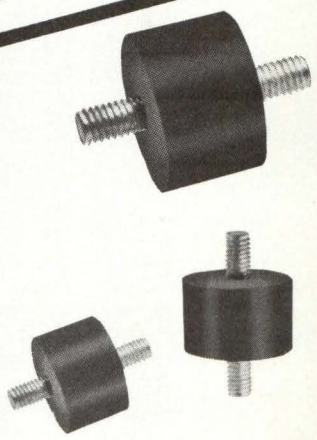
Fast, high density PROMs

Typical access speed for both 63S3281A and 63S3281 32K PROMs is 31 ns; max speed for the former is 40 ns, and 50 ns for the latter. The devices draw 190-mA max power from a 5-V supply, with typ power dissipation of 750 mW. Low current, pnp inputs, full Schottky clamping, and 3-state outputs are featured. Organized 4096 words x 8 bits, the PROMs are pin compatible with industry std Schottky PROMs. They come in 0.6" (1.5-cm) wide, 24-pin cerDIPs or 32-pin LCCs. **Monolithic Memories,** 1165 E Arques Ave, Sunnyvale, CA 94086.
Circle 375

Chopper-stabilized op amp

Model TML7650 features 1-μm input offset voltage and 10-pA dc input bias current. It offers 2.5-V/μs slew rate, 2-MHz gain-bandwidth product, 120-dB (min) common mode and power supply rejection ratios, and low intermodulation effects (less than 10° phase shift). The device is internally compensated for unity-gain operation and includes a clamp circuit to prevent overload recovery problems. Low offset is achieved by comparing inverting and noninverting input voltages in a nulling amplifier that spends alternate clock phases nulling itself and the main amplifier. **Telmos, Inc,** 740 Kifer Rd, Sunnyvale, CA 94086.
Circle 376

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CIRCLE 165

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The new family of versatile moldable, formable, extrudable NORYL resins was developed expressly for computers and business equipment, to terminate ABS's usefulness. Design-in just the UL requirement you need, for greater performance at a cost lower than or comparable to FRABS. Everything from low voltage applications to added resistance to ultraviolet light.

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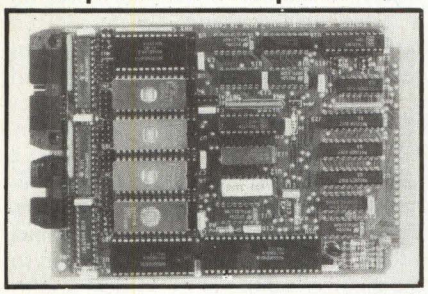
CIRCLE 164

SMC-70 upgrade to 16 bits

Designed to upgrade the SMC-70 8-bit computer to 16-bit performance, the Supercharger uses an Intel 8086 CPU operating at 5 MHz. The combination features 256K bytes of onboard memory expandable to 768K bytes and concurrently supports CP/M and MS-DOS operating systems. Communication between the Supercharger and the SMC-70 occurs via I/O port handshaking or direct memory access. The unit operates over a 5 to 35 °C temperature range. **Sony Microcomputer Products Div, Sony Corp of America**, 9 W 57th St, New York, NY 10019.

Circle 377

Slave processor with parallel I/O



Model DSTD-103, an intelligent Z80A based slave processor with parallel I/O, implements multiprocessing capability on the STD Z80 bus using DMA-request control lines. Up to 4 DSTD-103s can be used per backplane in 4-MHz systems. Each card can access all external RAM and I/O on the STD bus. Board includes 4 programmable counter/timer channels buffered to an external connector. Two 8-bit parallel I/O ports can be configured for TTL or open-collector outputs. Five byte-wide sockets can accommodate RAM, EPROM, or EEPROM. The DSTD-103 operates from the STD bus system clock signal. **dy-4 Systems, Inc**, 888 Lady Ellen Pl, Ottawa, Ontario K1Z 5M1, Canada.

Circle 378

Graphics workstation

The Advanced Raster Workstation runs on Digital Equipment Corp's VAX processors and Sperry Univac's V77 Series computers to furnish 1024- x 1024-pixel resolution. It comes in monochromatic or color versions. The color display can support 16 or 64 simultaneous colors, selectable from a palette of 16M colors. A separate 9″ (23-cm) alphanumeric screen supports 24 lines of 80 chars each. **Auto-trol Technology Corp**, 12500 N Washington St, Denver, CO 80233.

Circle 379

Multiterminal computer system

Within the Tiger family, ATS 32 and ATS 64 computers provide 32 and 64 ports, respectively. This allows them to support large numbers of terminals simultaneously, without response-time degradation. Sixteen-bit processors operate at 3 architectural levels within the units to perform preallocated system functions and to work with the other processors. Transaction processors handle short-duration transactions at rates to 19.2k bps; intranet processors serve as system resource managers, and the control biprocessors optimize disk access. Prices range from less than $30,000 to more than $250,000. **CADO Systems Corp**, 2771 Toledo St, Torrance, CA 90503. **Circle 380**

MICROPROCESSORS/ MICROCOMPUTERS

Multibus compatible, 68000 SBC

ModulasTen M68K10 is a 68000 based single-board computer for use on Multibus/IEEE-P796. It features 256K bytes of onboard RAM, Multimodule capability, multiprotocol serial communications, and parallel control. The 10-MHz 16/32-bit computer accesses onboard 128K-byte DRAM without wait states. Two 8-bit iSBX Multimodule I/O connectors permit quick customization of onboard I/O. With 24-bit addressing, the computer can access all 16M bytes of system address space. Upgrade to 256K-bit DRAMs provides 1M-byte onboard RAM. Quantity-1 list price is $1995. **SBE, Inc**, 4700 San Pablo Ave, Emeryville, CA 94608.

Circle 381

Second-source 8051 8-bit micro

Am8051PC (plastic) and Am8051DC (ceramic) 8-bit microcomputer ICs are alternate parts for the Intel 8051 chip. Fabricated using N-channel Sigate MOS technology, the substitute part is geared for applications requiring up to 64K bytes of program and/or data storage. The chip contains 32K (4K x 8) mask programmable ROM; a 128 x 8-bit RAM; 32 I/O lines; two 16-bit counter/timers; and a 5-source, 2-priority level nested interrupt structure. A serial I/O port for either multiprocessor communications, I/O expansion, or full-duplex UART, and an onchip oscillator/clock circuit are included. The 8031 ROMless version is also available. **Advanced Micro Devices Inc**, 901 Thompson Pl, Sunnyvale, CA 94086.

Circle 382

68000 based VME bus SBC

Model IV-1600 achieves 12-MHz performance without wait states in conjunction with its 256K-bytes of onboard RAM. In addition, it offers dual-port RAM with proprietary anti-deadlock circuitry that lets other CPUs and DMA controllers on the VME bus access the onboard RAM. The board also offers an onboard VME bus controller, as well as RS-232, RS-422, and current loop interfaces. It can serve as its own development system; 28-pin universal memory sockets allow use of EEPROMs. **Ironics Inc**, 117 Eastern Heights Dr, Ithaca, NY 14850.

Circle 383

16-bit SBC enhancements

A family of products for the iSBC 286/10 is targeted at the high end of the 16-bit single-board computer market. It features the /10ES development kit, C/X memory boards, 580 multichannel and iLBX bus expansion boards, 428 universal memory site expansion board, and the iSDM 286 system debug monitor, along with the iRMS 286R realtime operating system. High speed math functions, large memory capacity, 24-bit addressing, low interrupt latency, and 2 industry std operating systems suit the family to many high performance applications. **Intel Corp**, 3065 Bowers Ave, Santa Clara, CA 95051.

Circle 384

Portable CP/M microcomputer

With CP/M compatibility and 128K bytes of bank switching RAM, MicroMate offers power as well as portability. Both computer and 390k-byte disk fit into a 13″ (33-cm) long case about the size of a 5¼″ disk drive. Compatible with asynchronous terminals, the unit interfaces to asynchronous serial printers, Centronics type parallel printers, and Winchester disks (ST506). The computer offers an 80 x 24 screen format; T/Maker III application software comes with system. Complete system is $1495; without terminal, $995. **Personal Micro Computers, Inc**, 475 Ellis St, Mountain View, CA 94043.

Circle 385

Talk to the editor

Have you written to the editor lately? We're waiting to hear from you.

Circuit board test system



The 2275 circuit board test system, compatible with the company's 2270, 2271, and 2272 test systems, has up to 640 fully hybrid pins housed in its 44″ (112-cm) cubed design. The tester can be easily configured in test only mode and in closed or open configuration. Program preparation can be completed on any 227X tester and transferred to the 2275. For digital testing, each point has a driver/sensor backed by local memory. For analog testing, 14-bit instrumentation provides high accuracy. A 4-line instrument switching matrix gives each pin programmable access to system and external instruments. Prices begin at $105,000. **GenRad, Inc,** 300 Baker Ave, Concord, MA 01742.
Circle 386

Automatic drive tester/exerciser

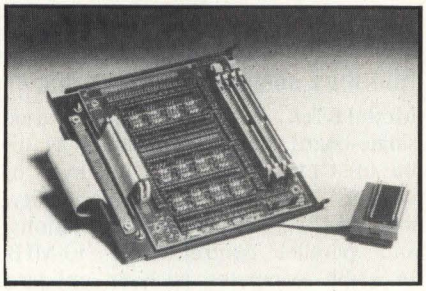
Fully automatic self-contained microprocessor driven tester/exerciser, model 723S simultaneously handles up to 8 Sony OA-D30V 3½″ diskette drives. It ties a Z80 microprocessor to 4K-byte RAM and 16K-byte EPROM. Unit automatically verifies R/W functions using random worst-case data patterns, depending on recording format (FM/MFM), or using optional 15-byte patterns entered manually. It can operate in read only mode using diskettes previously recorded with worst-case patterns. Tests include index and step periods, auto-seek through all step periods of R/W head positioner, track zero sensor, and automatic head-load. Price is $4195. **Brikon, Inc,** 22981 Alcalde Dr, Laguna Hills, CA 92653.



Circle 387

Interfaces for HP 64000

Two interface modules for the HP 64620S logic state/software analyzer are a user-defined general purpose interface and an 8086/8088 microprocessor dedicated interface. Signals are conditioned on 60 input lines. Bus signals can be demultiplexed, and stimulus and halt lines provide processor control. Inverse-assembly software generates analyzer displays in the processor's mnemonics. HP 64651A general purpose interface includes breadboard, IC sockets, wirewrap terminals, and cable with processor socket for 40-, 48-, or 64-pin DIPs. HP 64653A preprocessor interface for the 8086/8088 traces activity in min or max operating modes with appropriate dequeuing, at 8-MHz clock rates. **Hewlett-Packard Co,** 1820 Embarcadero Rd, Palo Alto, CA 94303.



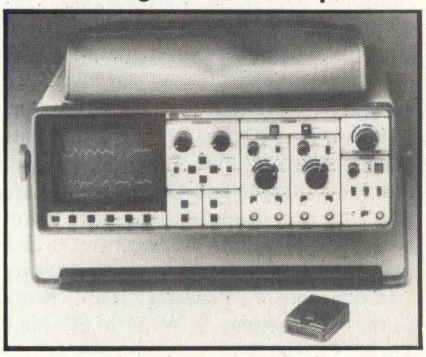
Circle 388

Multichannel analyzer

Using a touch-screen CRT to simplify operator inputs, Series 90 industrial measurement and control systems handle $2^{28}-1$ counts/channel, accept 64k data channels, and include user configurable, dual-port high speed RAM, expandable to 1M byte. A point-addressable, high resolution 13″ (33-cm) color graphics monitor is std; over 400 analog and digital I/O lines can be accommodated in each main chassis. Options include 20M bytes of disk storage and support for up to 16 users. The manufacturer offers a line of signal conditioners that suit Series 90 units to most sensors and controls. **Canberra Industries, Inc,** 45 Gracey Ave, Meriden, CT 06450.
Circle 389

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Did you remember to rate the articles in this issue of Computer Design? A special editorial score box is provided on the Reader Inquiry Card.

Portable digital oscilloscope



The 3091 digital oscilloscope for harsh industrial and remote field uses has a bubble cassette memory for nonvolatile waveform storage. Signals are stored on a removable cassette. With RS-232-C interface, waveform data can be sent to remote sites via telephone lines. X-Y and strip chart hardcopy recorders connect easily to the scopes' analog outputs. A 12-bit digitizer is combined with 2 sample/hold circuits to attain simultaneous 1-MHz sampling for both channels. The 4k-word memory length/channel adds 0.025% FS horizontal resolution to the digitizer's 0.025% FS vertical resolution. Each channel has differential and ac-dc coupling. Full-scale voltage ranges from ±100 mV to ±40 V. Price is $4300. **Nicolet Instruments,** 5225 Verona Rd, PO Box 4288, Madison, WI 53711.
Circle 390

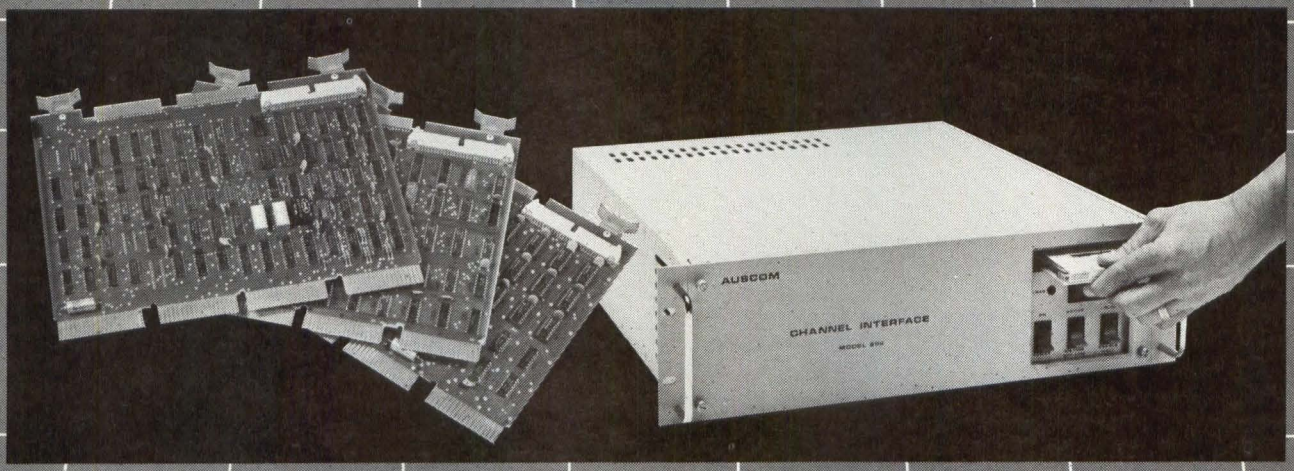
SYSTEM ELEMENTS

Switched capacitor filter arrays

Metal mask programmable CMOS semicustom arrays can implement up to 6 (model SCA-6) or 12 (model SCA-12) biquadratic filter sections or other switched capacitor filter architectures. Both arrays provide precision high order filtering on a single chip and can replace many active RC and discrete implementations in analog signal processing. Each biquad section of the uncommitted arrays has 2 op amps, 7 CMOS switches, 35 PMOS switches, and 60 programmable capacitor units. Buffer amplifiers and digital level shifters facilitate interfaces. SCA-6 also includes crystal oscillator, 8 toggle flipflops, and nonoverlapping clock generators. **Silicon Systems inc,** 14351 Myford Rd, Tustin, CA 92680.
Circle 391

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Auscom's 8900 and 8911 Can Interface Anything to An IBM Mainframe.



Auscom, Inc. offers a whole array of IBM-related capabilities using proven, reliable Auscom interface equipment. If you've had problems integrating other systems to your IBM mainframe, Auscom's Model 8911 Channel Interface and 8900 Channel Interface Card Set can supply the solutions. Auscom products provide cost-effective, field-tested, and fully supported methods of interfacing in the areas of networking, exotic peripherals, telecommunications, CPU-to-CPU adaptors, and custom interfaces.

More specifically, Auscom's channel interface products will interface your IBM mainframe to:

LOCAL AREA NETWORKS—Transform your IBM mainframe into a node on Ethernet, IEEE-488, X.25, or custom local area networks. The 8900 is programmable and buffered. Serves as a node controller or a message switcher to relay to your own controller.

EXOTIC PERIPHERALS—Directly connects graphics systems, laser printers, backend data-base machines, plotters, foreign terminals, array processors, etc. to IBM channels. Standard IBM device can be emulated in all applications to eliminate need for modification of the IBM operating system.

TELECOMMUNICATIONS—Programmable as front-end processors for custom TCOM applications. Microwave, satellite, fiber-optic, coax, and high-speed dedicated lines can be directly linked to an IBM channel.

CPU-TO-CPU ADAPTORS—Channel-to-Channel configuration via multiple mainframe connection. Directly connects most computers to an IBM or IBM lookalike channel.

CUSTOM INTERFACES—Software source code and development systems provided to allow users to build their own interfaces from Auscom board-level components.

For further information on the Auscom IBM to Anything Interfaces, contact:

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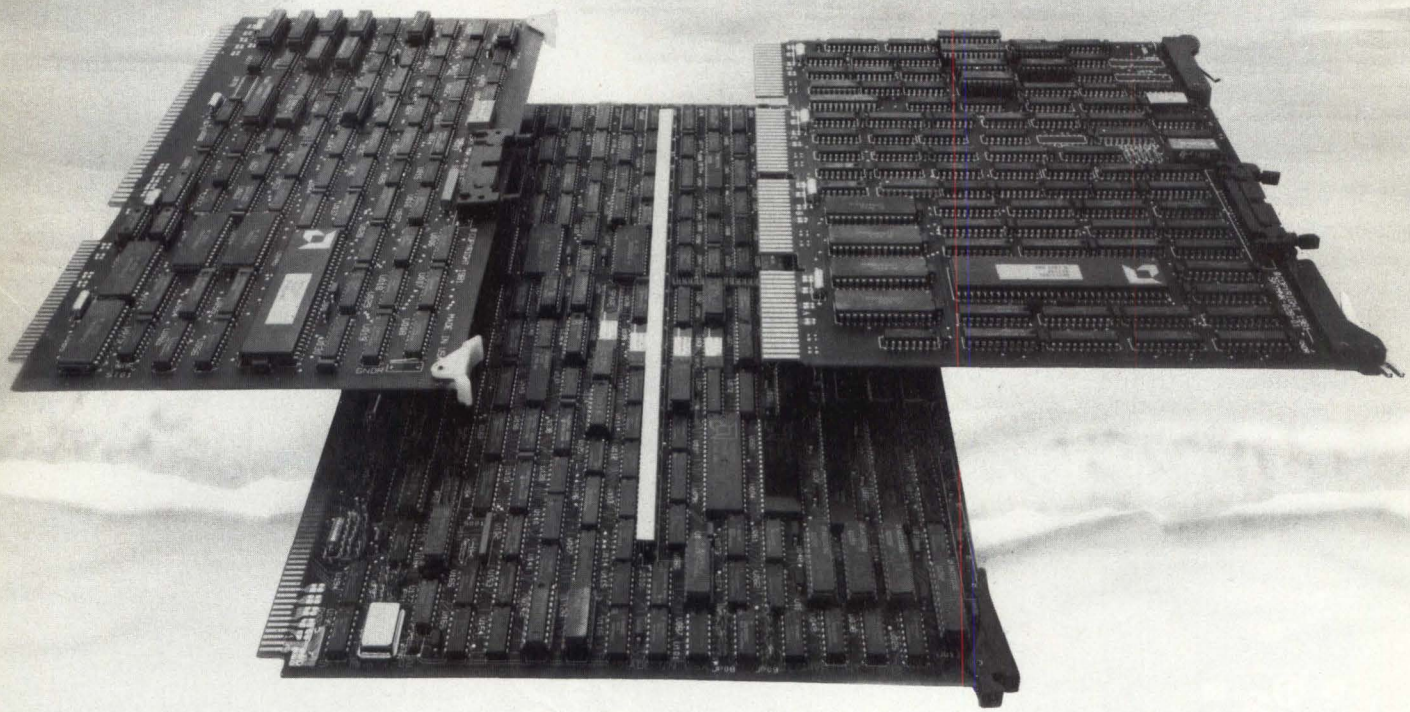
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CIRCLE 166

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Array Processors

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- MULTIBUS for Intel 8086, Motorola M68000
- VERSABUS for Motorola M68000
- One million floating point operations per second
- Plugs right into system bus
- Under $6000 with quantity discounts available
- Full 32-bit floating-point format (DEC or IEEE-754)

Floating Point Accelerators

- SKYFFP
- MULTIBUS, VME bus or S-100 bus plug-in board
- 32-bit and 64-bit IEEE standard floating point operation
- Compatible with MC68000, Z8000, 8086, 8085, Z80, and more
- User transparent - no changes to FORTRAN, Pascal, 'C', UNIX
- User microprogrammable
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SKYFFP Patent Pending.

CIRCLE 159

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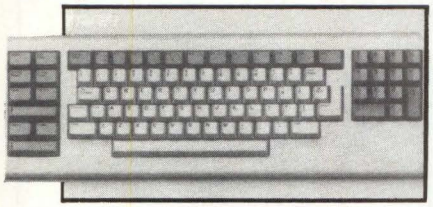
SKY

SKY COMPUTERS, INC. Foot of John Street Lowell, MA 01852 (617) 454-6200 TELEX 4991331 SKYMNK

INTERNATIONAL DISTRIBUTORS (DEC, Multibus, Versabus Compatible Products): Belgium: C.N. Rood 07/352 135; Canada: Transduction 416/625 1907; France: Metrologie 01/791 4444; Italy: Morra Ingegneri 01/724 22577; Japan: ASR International 03/437 5471; Netherlands: C.N. Rood 070/996 360; Switzerland: Techex AG 01/825 0949; Taiwan: Hermes Epitek 02/562 5851; United Kingdom: Data Translation 06/286 3412.

INTERNATIONAL DISTRIBUTORS (Multibus Compatible Product Only): Finland: Oy Fintronic 090/692 6022.

Low profile full-travel keyboard



The KD131 full-travel keyboard measures under 19 mm from keycap to frame assembly, with an overall height under 25 mm. A full 0.150″ (0.381-cm) travel is maintained while meeting the 30-mm DIN spec. Keyboard comes with or without enclosure. Numeric pad, function keys, auto-repeat keys, separate cursor control pad, and lighted LED shift key are included. A 10-bit 300-baud serial async RS-422 output is provided, with all signal levels TTL compatible positive logic, capable of driving at least 1 TTL load. **Digitran, a Becton Dickinson Co, Keyboard Div,** 855 S Arroyo Pkwy, Pasadena, CA 91105.

Circle 392

Brushless 9.25″ pancake motors

A radial air gap motor features rare earth magnets, high torque to inertia ratio, very low cogging, and long life. The short profile motors range in continuous stall torque from 45 to 100 lb/in (5 to 11 N•m). Hall effect sensors in the brushless motor provide precise shaft position information for electronic commutation. The unit can be used in dc and variable frequency ac drives. Standard options include a low ripple brushless analog dc tachometer, encoders, resolvers, and brakes. **Honeywell Motor Products Div,** 4301 Kishwaukee St, PO Box 106, Rockford, IL 61109.

Circle 393

High output, long-life LED

The Illuminator gives light output comparable to a filtered 0.5-W incandescent lamp, with reported life expectancies of 100k to 1M hours. Encapsulated in a T1-3/4 package, the lamp comes in red or yellow, with 25- or 50-mcd intensity ranges. Chief application is backlighting areas over 1 in^2. Package contains a clear lens with built-in light reflector for 140° viewing angle. The lamp is resistant to shock and vibration and can be used where incandescent filaments will shatter. **General Instrument, Optoelectronics Div,** 3400 Hillview Ave, Palo Alto, CA 94304.

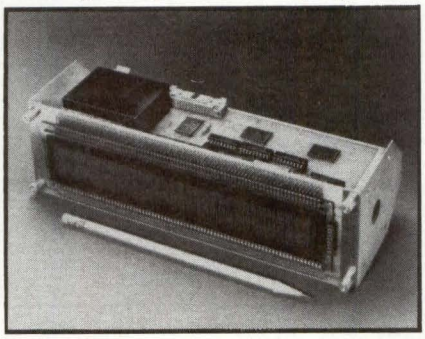
Circle 394

Membrane switch

Type F45 membrane switch operates to a max continuous temp of 45 °C at costs typically 40% less than 65 and 85 °C switches. The switch has a 0.005″ (0.013-cm) thick polyester layer with B9257 conductive circuitry folded to form flex and stable layers. Tail exits in a planar fashion. A 0.001″ (0.003-cm) XB 9207 insulative coating covers all nonkey area conductive tracks to protect circuitry. A 0.002″ (0.005-cm) thick proprietary insulative material with adhesive holds the switch layers together, constitutes a spacer between circuit layers, and seals from particulate contamination. **W.H. Brady Co, Xymox Div,** 8225 W Parkland Ct, PO Box 571, Milwaukee, WI 53201.

Circle 395

Intelligent "plasma" display



A microprocessor controlled, 64-char dot-matrix display system offers 150° viewing area and typical brightness of 190 ft-L. Type APD-064M026 provides plasma display aesthetics without the need to design drive electronics, interface, and voltage conversion circuitry. Chars are 0.26″ x 0.16″ (0.66 x 0.41 cm), formed by a 5 x 7 dot matrix in 2 rows of 32 chars each. Internal generator provides a 160-char set, including ASCII and Katakana chars. The user-enabled cursor can be fully addressable or auto-incremented. **Dale Electronics, Inc,** 2064 12th Ave, Columbus, NE 68601.

Circle 396

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CIRCLE 198

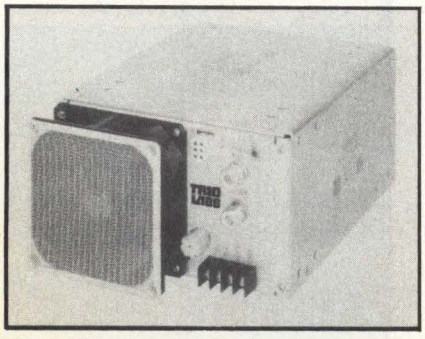
Linear power with 15-Vdc output



Six linear power modules provide from 3.0- to 7.5-W output power and are available in PCB or chassis mount packages. Series features outputs of 15 Vdc at 200, 350, or 500 mA. PCB mount models provide line regulation of ±0.02% max with load regulation of ±0.02% max (200- or 350-mA output) or ±0.04% max (500-mA output). Chassis mount models provide line and load regulations within ±0.05%. Ripple and noise is 0.5 mV rms max (200-mA output) or 1.0-mV rms max (350- or 500-mA output) on PCB mount models, and 1.0-mV rms max on chassis mount models. All units have I/O isolation up to 2500 Vac, output voltage accuracy within ±2.0%, tempco of ±0.02%/°C typ, and short-term current limit short circuit protection. **Computer Products, Inc, Power Products Div,** 2801 Gateway Dr, Pompano Beach, FL 33060.
Circle 397

750-W switching power supplies

The enhanced 682 series of switching regulated power supplies for digital and memory systems feature dual, selectable 115/230-Vac input, full power output at 71 °C, and up to 2 W/in^3 volume. Output levels range from model 682-02 with 150 A at 2 V to model 682-48 with 19 A at 48 V. **Trio Laboratories, Inc,** 80 Dupont St, Plainview, NY 11803.

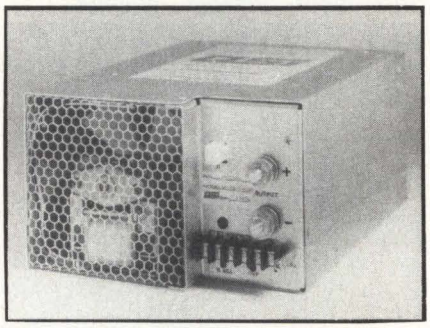


Circle 398

High power switching supplies

RE800 series switching power supplies have no internal wire harnessing problems found in single-board designs. Only computer grade, UL/CSA circuitry components are used. Features include 24-V, semiregulated available fourth channel; auxiliary output currents to 30 A; industry std 5″ x 8″ x 11″ (13- x 20- x 28-cm) profile mounting patterns, and connections. Safety features comply with UL/CSA/VDE/IEC. User selectable input range is 90 to 132 Vac, 165 to 250 Vac, and 180 to 264 Vac. Single-, dual-, triple-, and quad-output models are available. Prices begin at $875. **ACDC Electronics,** 401 Jones Rd, Oceanside, CA 92054.
Circle 399

48-Vdc 750-W single-output supply

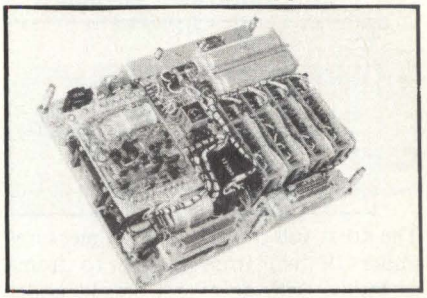


The 6010 series 750-W single-output 48-Vdc input power supply is housed in an industry std 5″ x 8″ x 11″ (13- x 20- x 28-cm) package. The supply provides output voltages ranging from 2 to 48 V with a 750-W max capability. Remote sense, thermal shutdown, foldback current limiting, and an MTBF greater than 50k hours are standard. The system is forced air-cooled and is rated at 60% efficiency. **Qualidyne Systems, Inc,** 2256 Main St, Chula Vista, CA 92011.
Circle 400

International dc power supplies

International series of dc power supplies include 76 off-the-shelf models that comply with such regulatory safety agencies as UL, CSA, IEC, VDE, BPO, ECMA, and CEE. Each unit provides 100-, 120-, 220-, 230-, and 240-Vac, 47- to 63-Hz input ranges needed for worldwide operation. All units use high C/V density filter capacitors with high RMS ripple current ratings. Single-quantity prices start at $32.95. **Power-One Inc,** Power One Dr, Camarillo, CA 93010.
Circle 401

Modular switching supply



Model M7935 240-W power supply provides outputs of 5 Vdc at 15 A, 12 Vdc at 4 A, ±15 Vdc at 2 A, and 28 Vdc at 2 A. Input voltage is 115 Vac at 400 Hz, single phase. Op temp range is −40 to 85 °C; max cold plate temp is 75 °C using conduction cooling. Auxiliary outputs achieve high efficiency and synchronization to the 5-V output main rail via magnetic amplifier post regulated module. No high power switching or linear pass transistors are used. The 75% efficient unit is manufactured to MIL-T-28800B and MIL-STD-454. **CEAG Electric Corp, Power Supply Div,** 1324 Motor Pkwy, Hauppauge, NY 11788.
Circle 402

Uninterruptible power supply

DPS series of uninterruptible power supplies are available with single, double, or triple dc outputs, and in 250-, 500-, 1k-, and 2k-W output sizes. Full range dual voltage ac inputs and high frequency power MOSFET switching for compact size and low emi are provided. Units comply with all UL, CSA, FCC, and VDE requirements. Each of the 4 series models has a backup unit that interfaces between the power supply and a std battery system. The backup draws power from the DPS during normal operation and charges the std sealed lead acid battery packs. **Displex, Inc,** 79 Hazel St, Glen Cove, NY 11542.
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Already the standard of the industry.

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Versatility is the key to success in the field and Datatest I has it in spades. In fact, no other test set this compact even comes close to its wide range of capabilities. And we've built it to be rugged and reliable in the field.

Datatest I. Best by any test.

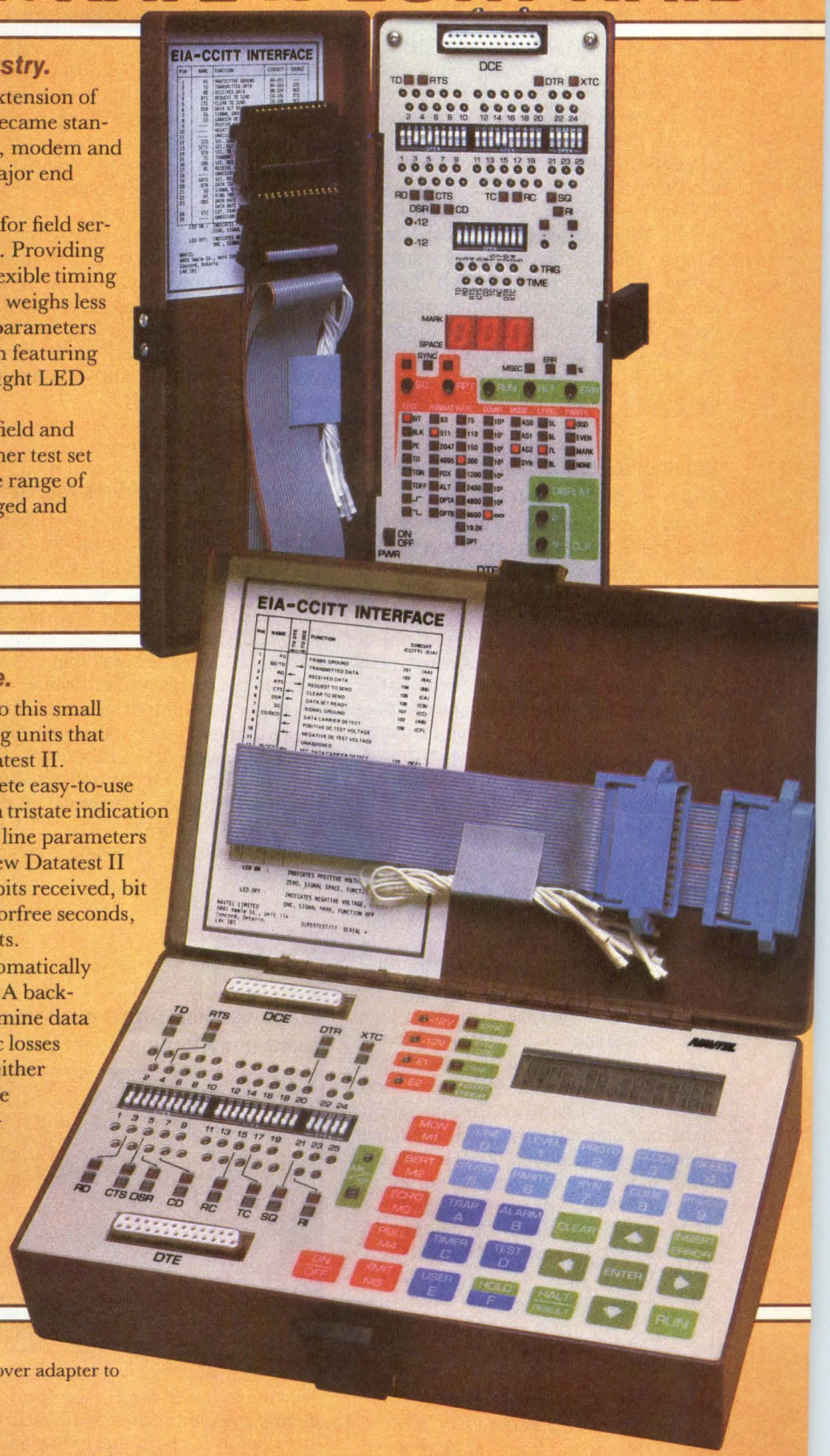
Datatest II

Test miracles in a small package.

It's hard to believe, but we have built into this small package, test set capabilities of competing units that are five times the size and weight of Datatest II.

Datatest II provides you with a complete easy-to-use integral EIA RS-232C breakout box with tristate indication of interface status. All test functions and line parameters are menu selectable. Our outstanding new Datatest II **simultaneously** measures and displays bits received, bit errors, blocks received, block errors, errorfree seconds, errored seconds, sync losses and time outs.

At the end of your test Datatest II automatically calculates both bit and block error rates. A background trap and timer allows you to examine data around errors, events, characters or sync losses or analyze response times. The user can either define his own messages or use **any of** the pseudo random or Fox patterns. Preprogrammed DCE or DTE configuration is selected electronically so that the Datatest II can test terminals, printers, point-to-point communications facilities, multi-drop networks and X.25 facilities.



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$1,595.00 includes a leather case and a turnover adapter to facilitate terminal testing.
3⅜ in. wide x 9 in. high x 2¾ in. deep.

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CIRCLE 169

Board-type EPROM programmer

The ZX-914 for 28-pin 2700 devices features gang programming and verification, separation of high and low bytes for word-wide systems, and implementation of Intel's fast programming algorithm. Software utilities are provided for ISIS or CP/M. The programmer operates in 8- or 16-bit systems and inserts directly into 1 Multibus backplane card slot; jumper and/or switch changes are required for 2764, 27128, or 2817 EPROM devices. All programming voltages derive from onboard power supplies. **Zendex Corp,** 6644 Sierra Ln, Dublin, CA 94568.
Circle 404

Communications utility integrates minis or mainframes

"Talk" communications utility turns an Intel Development System series 200 or 300 into a virtual terminal that can communicate over std RS-232 lines to a remote computer. Written in PL/M, the software is provided in both source and object form on single- or double-density ISIS format diskettes for $500. It includes full rubout, scroll, interrupt control functions, and control of the baud rate used by the Development System terminal. **Intermetrics, Inc,** 733 Concord Ave, Cambridge, MA 02138.
Circle 405

STD bus micro development

Model DV-9 realtime software development system for board-level microcomputers supports Pascal, COBOL, BASIC, C, D-Forth, and assembly language. The self-contained package includes 2 independent systems for application development: 1 for generating and maintaining source code and enhancing OS-9 based programs, and another for configuring hardware and software. Dual backplane architecture includes a 2-MHz 6809 CPU with 62K-byte memory, 3 serial I/O ports, and 32 bits of parallel I/O. **Datricon Corp,** Datricon Plaza, 155 B Ave, Lake Oswego, OR 97034.
Circle 406

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Peripheral processor emulators

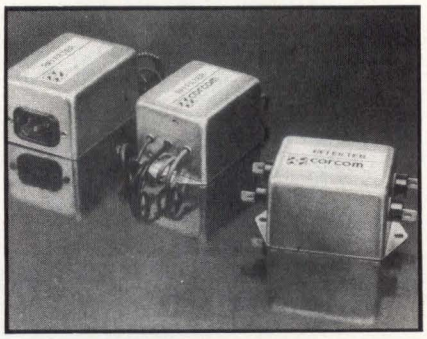
Two development tools for peripheral interface processors provide full-speed realtime emulation with precise circuit timing and load/drive matching. In-circuit emulators ICE-44 (for the 8044 distributed intelligence microcontroller) and ICE-42 (for the 8042 universal processor) speed software development through symbolic debugging. Other features conditionally halt emulation, record execution history in trace locations while operating at a 12-MHz clock rate, and patch test fixes into runtime code. Both emulators are compatible with Intellec® Series II or III systems. **Intel Corp,** 3065 Bowers Ave, Santa Clara, CA 95051.
Circle 407

Multibus graphics/data interface

Video disk interface VDI-1 enhances applications that use std NTSC laser video disks. Three-board set contains a Multibus interface, 4-input video switch, a flash video ADC, phase-locked video timing circuits, memory/display access and automatic hidden refresh timing circuits, 4-frame wide black and white video memory, a 2-output video DAC, and video timing pulse outputs. Picture memory space is 768 x 1K x 6 bits with a 378- x 483-pixel roving refresh display window. **Matrox Electronic Systems Ltd,** 5800 Andover Ave, T.M.R., Quebec, H4T 1H4, Canada.
Circle 408

EMI PROTECTION

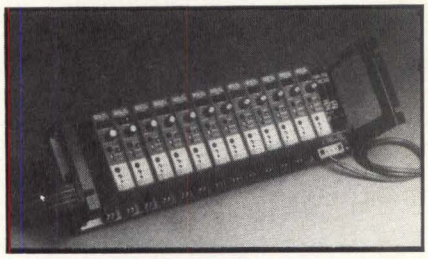
RFI power line filters suppress noise in switching supplies



The Q series rfi power line filters for switching power supplies control conducted emissions down to 10 kHz. High attenuation for both line to line and line to ground interference is provided throughout the frequency range and ensure no performance degradation due to peak currents drawn by equipment. Series is suited to applications that meet B level limits of VDE 0871 below 150 kHz and FCC part 18 from 30 MHz down to 10 kHz. Std leakage current (VQ series) and low leakage version (EQ series) are available. All models are UL recognized, with CSA and VDE approvals pending. Three case styles and rated current of 3 A at 115 Vac or 2A at 250 Vac, 50 to 60 Hz with a rated voltage of 115/250 Vac are available. **Corcom Inc,** 1600 Winchester Rd, Libertyville, IL 60048.
Circle 409

CONTROL & AUTOMATION

Modular alarm limit subsystem



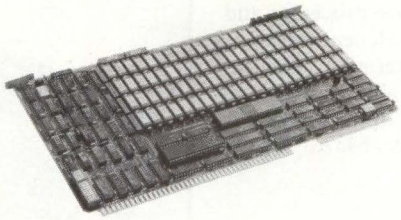
The 4B series has plug-in modules that accept a high level voltage or 4- to 20-mA/0- to 20-mA input and 2 independent on/off outputs for high/low limit monitoring. Three-digit display for set-point calibration and indication of both set points and the process variable are featured. All modules offer 130-V rms normal mode protection, ±0.1% accuracy, and ±0.005% span/°C drift. **Analog Devices, Inc,** Rte 1 Industrial Park, Norwood, MA 02062.
Circle 410

Rugged 16K, 5-V EEROM

A 5-V only 16K EEROM is specified at 350-ns read access time and 10-ms byte write over −55 to 125 °C temp range. Model DM5213 is available for prototyping; DM5213/B is screened to MIL-STD-883B and is available for production. Both are organized as 2K x 8 bits in JEDEC approved, MOS byte-wide memory configurations. They are initially available in 24-pin DIPs and will be available in 32-pin chip carriers. Each byte can be erased or written up to 10k times. Using the 21-V write capability, the EEROM is pin compatible with the 2816 EEROM. **Seeq Technology, Inc,** 1849 Fortune Dr, San Jose, CA 95131.
Circle 411

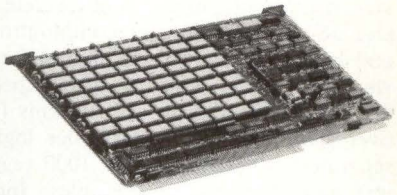
MULTIBUS* MEMORIES

DYNAMIC RAM (IEEE P796-COMPATIBLE)



MM-8086E

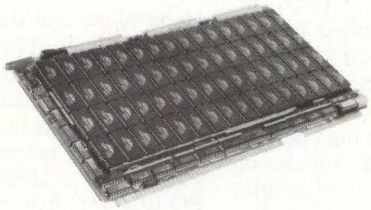
- 512K, 256K bytes
- Error detection and correction
- 1000_H boundaries/16 Mbyte address
- Access/Cycle: 300/500 nsec
- CSR/ESR for EDC control and LED error correction indication
- Battery backup option



MM-8086D

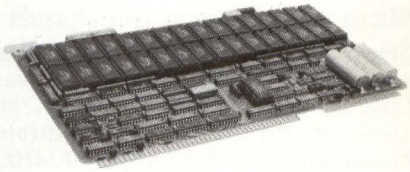
- 512K, 256K, 128K, 64K bytes
- For 8 and 16-bit processors
- 1000_H boundaries/16 Mbyte address
- Even parity with output selectable to any of bus interrupts
- ACCESS/Cycle: 250/400 nsec

NON-VOLATILE CMOS RAM (IEEE P796-COMPATIBLE)



MM-8000C

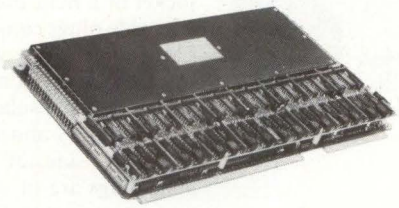
- 128K, 64K bytes
- Data retention (on-board batt.):
  2 weeks rechargeable batteries
- 4000_H boundaries/16 Mbyte address
- Access/Cycle: 220/220 nsec
- Battery status line allows monitored battery condition
- Redundant batteries provide improved reliability
- Accommodates 2716 EROM



MM-8086C

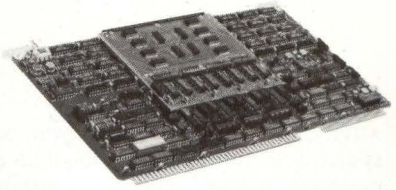
- 64K, 32K, 16K bytes
- Data retention (on-board batt.):
  3 weeks rechargeable batteries
  2 yrs. non-rechargeable batteries
- 1000_H boundaries/16 Mbyte address
- On-board calendar/clock
- Access/Cycle: 250/250 nsec
- Redundant batteries provide improved reliability
- Accommodates 2716 EROM

NON-VOLATILE CORE MEMORY



MM-8086

- 32K bytes
- For 8 and 16-bit processors
- 1000_H boundaries/1 Mbyte address
- Access/Cycle: 375/1200 nsec
- Power monitoring for data protection



MM-8086/16

- 16K bytes
- For 8 and 16-bit processors
- 4000_H boundaries/1 Mbyte address
- Access/Cycle: 280/800 nsec
- Power monitoring for data protection

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micro Memory Inc

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CIRCLE 167

Small- to mid-sized PC

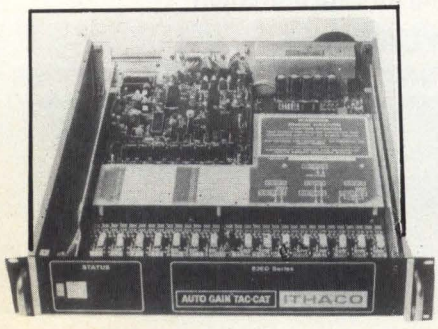
A modular programmable controller system supports 256 points of discrete 8- and 16-point I/O in any combination, and can update 16 registers or analog I/O variables with each scan. In high speed CMOS RAM, the 884 stores programs for over 2000 nodes of relay ladder logic; separately, it provides over 1000 registers and 1024 on/off variables. Individual microprocessors are dedicated to logic programs, high speed communications between the 884 and I/O modules, and communications between the 884 and external devices. **Gould Inc, Modicon Programmable Control Div**, PO Box 83-SVS, Andover, MA 01810.
Circle 412

Micro in front-removable chassis

Suited to applications involving data acquisition, factory and office automation, and automatic test equipment, the Diskstor M-2 Multibus-compatible microcomputer includes a 10-MHz, 16-bit 8086 processor, 128K bytes of memory, serial and parallel interface ports, and a dual, double-sided floppy-disk drive. Cast-aluminum front bezel pops off for easy access to the 8-slot Multibus card cage. To facilitate maintenance, the entire chassis assembly can be removed from the front. Three fans in a push/pull configuration provide cooling, and a 200-W switching power supply furnishes system power. The unit costs $8590. **Comark Corp**, 257 Crescent St, Waltham, MA 02154.
Circle 413

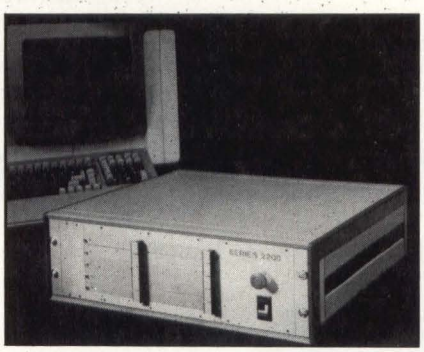
Data acquisition subsystem

AUTO-GAIN® TAC-CAT intelligent subsystem acquires remote analog data and measures voltage, current, resistance, and thermocouple inputs. Optical coupling and individual channel relay switching provide 250-V peak isolation, input-to-input, and input-to-ground. Self-calibrating features and V/F measurement technique yield 6-digit precision. Subsystem has Z80 processor and resident firmware for independent operation via attached CRT terminal. Continuous memory scanning allows immediate access to data and limit checking. **Ithaco, Inc**, PO Box 6437, Ithaca, NY 14850.
Circle 414



Semicustom automation system

The 2200 series controller provides motion, process, and programmable control in a single system. It has a 32-bit NS16032 microprocessor, double Eurocard CPU module format, and DIN pin/socket connectors, and can accommodate a 64K-byte mix of RAM, EPROM, and EEPROM. Any combination of 3 axes of open- or closed-loop stepper, or ac/dc servo can be controlled by the Axis Control Interface (ACI). The ACI also provides 24 I/O channels for system interfacing. A single-processor system can control up to 12 axes of high performance motion. Available as modules or as packaged control systems with software, power supply, and cooling fan filter, series costs $2100 to $2700. **Modular Systems Research**, 1665 E 18th St, Tucson, AZ 85719.

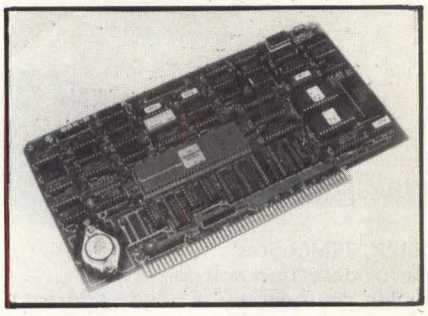


Circle 415

Unit operations controllers

Redundancy in Prōvox® is available for batch processing that requires a fault-tolerant control scheme. One online and 1 standby control unit came in the unit operations controller, the heart of the distributed batch control system. When active unit fails, control automatically switches to standby unit on an exception basis, without interrupting the batch process. Data transfer is handled as a parallel task. The redundant control unit connects to both primary and redundant data highways. **Fisher Controls International, Inc**, Marshalltown, IA 50158.
Circle 416

68000 based S-100 processor board

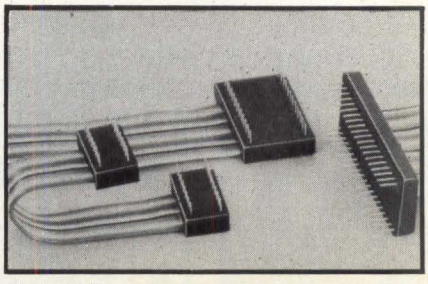


The 68000-P processor board has an 8-MHz MC6800L and can optionally go to 12 MHz. It addresses 16M bytes of RAM. In addition, it features three 16-bit interval timers for use as watchdog or task switching timers in multitasking environments. Board accommodates 8K ROM and is supplied with a Forth based monitor. It features full 24-bit address space, 16-bit data transfers, and 8 vectored interrupt lines. The std 256 I/O mapped ports and extended 64K of I/O mapped ports are supported. Extended vectored ID interrupt is available as jumper option. Price range for the 8-MHz version is $349 to $695. **Inner Access Corp**, PO Box 888, Belmont, CA 94002.
Circle 417

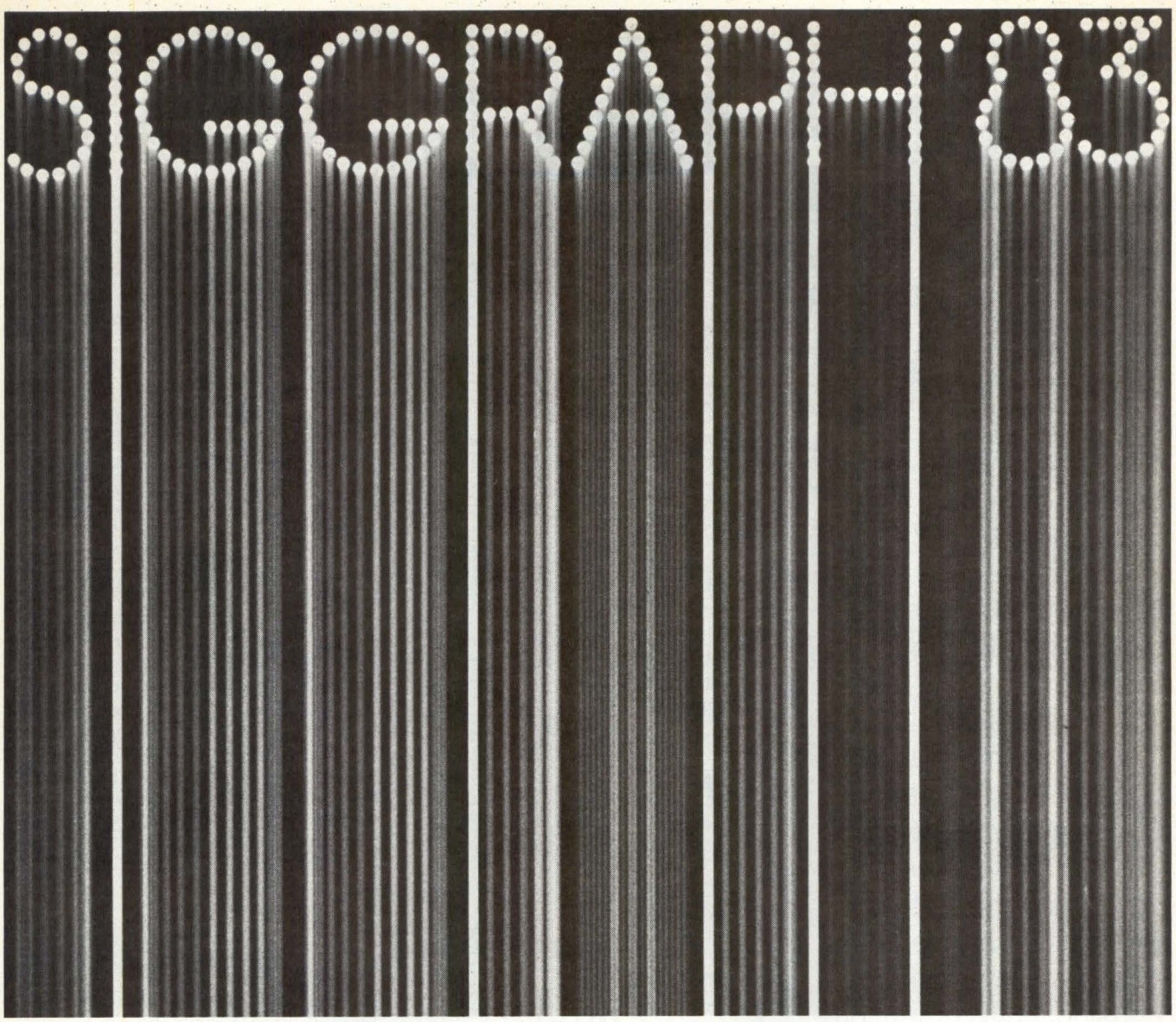
INTERCONNECTION & PACKAGING

Flat ribbon cable accessories

Color coded cable plugs in 8- to 64-pin conductor sizes are available in single- or double-end versions with a female socket or a male plug on 1 or more ends. All cable plugs come in twisted pair or as flat ribbon cable, with 26 AWG, PVC insulation. All connections are hand soldered, encapsulated, and 100% tested for continuity and shorts. Cable can exit from top, side, or end of plugs. Nylon male plugs are UL 94V-O with gold-plated brass terminals. Female sockets have precision machined lead sockets with heavy 4-finger gold-plated inner contacts. **Samtec, Inc**, PO Box 1147, New Albany, IN 47150.



Circle 418



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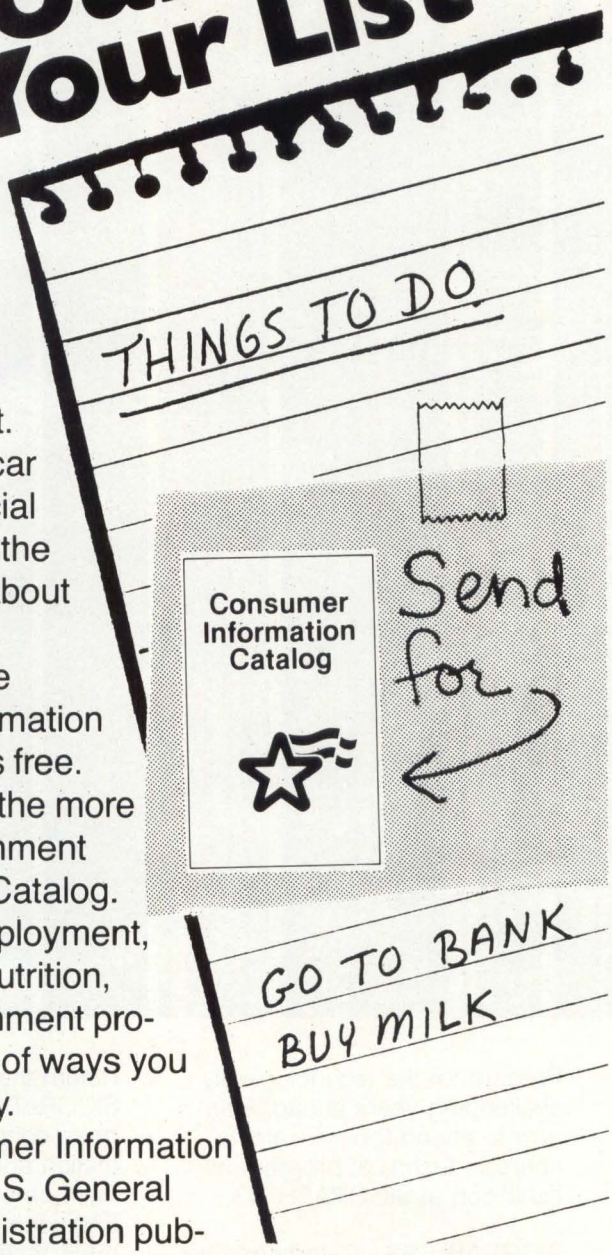
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CIRCLE 168

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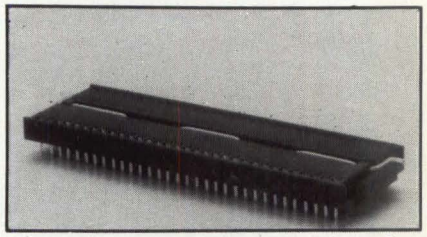
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GSA U.S. General Services Administration

64-pin ZIF socket

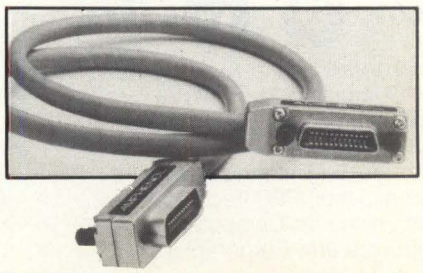


An addition to the Pro-Zif 0-insertion force family features a center lever that requires no tools for opening/closing of contacts. The IC is inserted easily into socket body and held in place by rotating the lever 90° to its lock position. Single-facewipe contacts on 0.9″ (2.3-cm) centers, beryllium copper contacts plated with 30 μn of select gold or 50 μn of tin are provided. Socket meets MIL-S-83734 and is molded of glass reinforced UL94V-O polyester. The 64-lead Pro-Zif costs $2.80 each in 10k lots. **Wells Electronics, Inc,** 1701 S Main St, South Bend, IN 46613.

Circle 419

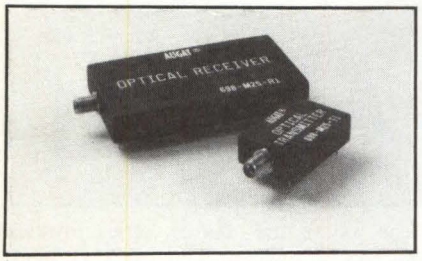
RFI shielded bus cables

Six connectorized bus cable assemblies feature double-shielded cable, plus added shielding around inner layers to minimize crosstalk between control and data lines. The 488 series assemblies have reduced overall rfi levels to meet or surpass MIL-STD-461A, VDE 0871, and VDE 0875. Typ cable capacitance is 120 to 130 pF/m. The cables are terminated with 24-contact Amphenol 57 series rack and panel connectors. Features include die-cast nickel plated aluminum shell that resists corrosion, provides added shielding, and has an overlapped seam for enhanced ground/shielding. Price range is $35 to $97. **Amphenol, div of Allied Electronic Components Co,** 2122 York Rd, Oak Brook, IL 60521.



Circle 420

Data link



M25 data link transmits digital data at rates from dc to a min of 25M bps with a 10^{-9} BER. With a 16-dB system loss budget, transmission lengths greater than 2 km can be obtained. The system can simultaneously transmit an analog signal up to 10 kHz. Two connector systems are available, including Augat's DSC designed to the proposed EIA standards. Price for the data link, without cables, is $259 in 100 lots. **Augat Inc, Interconnection Systems Div,** 40 Perry Ave, PO Box 1037, Attleboro, MA 02703. **Circle 421**

Reverse DIN connector

System with 2-piece connectors eliminates PCB gold fingers and allows easy backpanel access. Male pin on backplane has compliant pressfit termination with wirewrap tail. Female socket connector mounts on the daughterboard and has right-angle DIP solder tails. Both connectors have compliant contact section that seats in the hole of a PCB or a plastic insulator for metal backplanes, with an 8-lb (4-kg) min pushout force. Eurocard/DIN compatible packaging is available. **Stanford Applied Engineering, Inc,** 3520 De La Cruz Blvd, Santa Clara, CA 95050.
Circle 422

Shielded planar cable

The X40163 cable on 0.100″ (2.54-mm) center spacings and X8833 on 0.156″ (3.96-mm) centers consists of polyethylene-insulated signal conductors separated and shielded by a conductive polymer layer. Polymer adheres to an uninsulated drain conductor that grounds the shield. A layer of PVC coats the outside. Cable can be mass terminated in IDCs. The 0.100″ cable accommodates 28, 26, and 24 AWG and is available in 2 to 36 conductor positions. The 0.156″ cable accepts 26, 24, and 22 AWG and can be supplied with 2 to 24 conductors. **Molex Inc,** 2222 Wellington Ct, Lisle, IL 60532. **Circle 423**

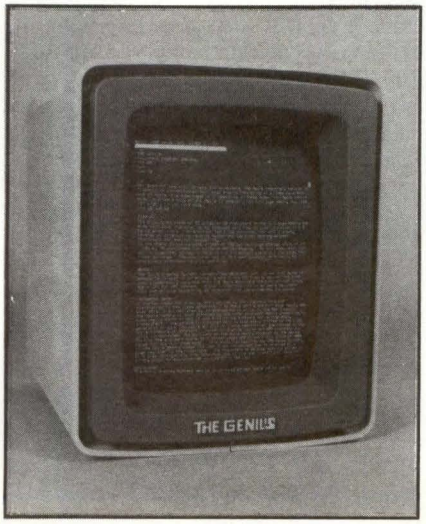
PERIPHERALS

Interactive graphics tablet

The HP 17623A interactive graphics tablet for the HP 2627A color graphics terminal uses a stylus instead of the terminal's arrow keys for quick graphics development. An Enter Point key improves digitizing accuracy by entering the point without need to apply pen pressure. An Invert Axes button rotates the tablet's coordinate system for left-handed use. Specialized symbols, chars, program controls, and electronic mail functions can be selected from menus in the tablet or from the terminal's display. Pixel resolution is 2048 x 1560 within a 295- x 217-mm active digitizing area. **Hewlett-Packard Co,** 1820 Embarcadero Rd, Palo Alto, CA 94303.
Circle 424

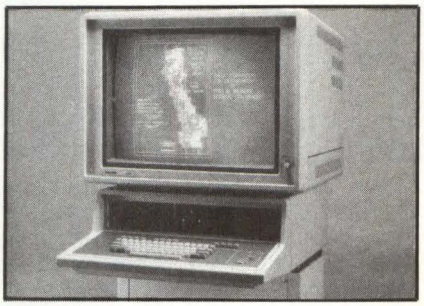
CP/M workstation for Burroughs

MTS 183 CP/M based workstation contains a Burroughs compatible terminal, computer with dual mini-diskette drives, application and utility programs with software documentation, and all required cables/peripherals. Std software includes CP/M version 2.2, WordStar, LogiCalc, Correct-It, Pilot, Personal Pearl Database Manager, and 2 versions of BASIC. Also provided is a utility to transfer files between the workstation and its host. Programmable function keys, addressable printer port, built-in daisy chaining, and a selectable TDI interface are also featured. **Micro-West Terminal Systems, Inc,** 1473 S 1100 East, Salt Lake City, UT 84105.



Circle 425

Large screen smart terminal



The model 4116A computer display terminal features a 25″ (635-mm) direct view bistable storage tube, 4096 x 3120 viewable resolution, and finely etched 10-mil wide vectors. Over 15k alphanumeric chars can be displayed simultaneously. Local intelligence retains picture segments or graphic primitives as a unit in local memory to be redrawn or manipulated at any time. Eight user programmable function keys are available. Two-dimensional transforms locally translate, rotate, and scale picture segments. Host communication transmission speed is 50 to 19k bps. **Tektronix, Inc,** PO Box 500, Beaverton, OR 97077. **Circle 426**

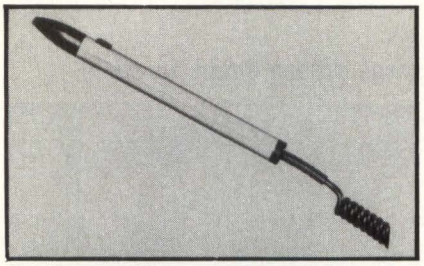
IBM 3279 compatible color printer

The ACT-1 can produce an 8.5″ x 11″ (21.6- x 28-cm) image on plain paper in 1.5 min. No software is required to operate the printer from the IBM terminal; pressing a pushbutton on the ACT-1 results in printout of a displayed image. Printer resolution is 85 dots/in vertical and up to 140 dots/in horizontal. The printer can produce 125 shades, including 7 solid colors. Yellow, cyan, and magenta inks are supplied in a single cartridge. **Advanced Color Technology,** 21 Alpha Rd, Chelmsford, MA 01824.
Circle 427

Hi-res color graphics terminal

Model 802 provides a 19″ (48-cm) diagonal color CRT screen with display capabilities of 48 lines x 80 chars. Any combination of 8 available colors can be selected for foreground/background use. There are 64 ASCII uppercase chars; 64 additional chars can include the 32-char ASCII lowercase set and/or graphic symbols. Graphic X-Y point plotting modes provide display point plots, bar graphs, and vector plotting on a 160 x 192 grid. Single-unit price is $3950. **Telpar Inc,** 4132 Billy Mitchell Rd, Addison, TX 75001. **Circle 428**

Fast response lightpen



Featuring stainless steel body with black anodized aluminum tip and tail, the Model 230 SB lightpen has a life expectancy of 3M operations. Push-button actuation requires less than 6 oz (0.2 kg) of pressure. The pen is designed specifically for use in moderate (2- to 20-ft-L) illumination; response to a 2-ft-L input is less than 0.5 μs. Self-contained unit operates from a single 5-V source and provides TTL-compatible outputs; power consumption is less than 100 mW. **Interactive Computer Products, Inc,** 831 S Douglas St, El Segundo, CA 90245.
Circle 429

Voice-recognition subsystem

Making speech input available as an add-on option for most ASCII terminals, model SYS300 voice recognition subsystem has a 100-word vocabulary and better than 99% accuracy. When inserted in the RS-232-C line connecting a terminal and host computer, it transforms spoken words into ASCII strings, which appear to the host as if they were generated via the terminal's keyboard. Thus, application software need not be altered to work with the voice input unit. SYS300-resident firmware allows users to define vocabularies without host programming. Single-unit price is $1995. **Interstate Electronics Corp,** 1001 E Ball Rd, PO Box 3117, Anaheim, CA 92803.
Circle 430

Color graphics system

System 1500 Multi-Station with 32-bit parallel interface for IBM, Perkin-Elmer, and DEC processors controls 1 to 4 workstations running CAD/CAM, signal processing, simulation, and mapping applications. Raster-scan CRT has 1024 x 1024 resolution, and supports 3-D graphics with rotation, scaling, and translation. Multiple viewports can be defined and transformed images clipped to boundaries in real time. With communication controller, the system supports 64 workstations up to 2 mi from host, at communication rates to 1.544M bps. **Spectragraphics Corp,** 10260 Sorrento Valley Rd, San Diego, CA 92121.
Circle 431

Optical mouse for IBM PC

Designed to operate with virtually all software packages that run on the IBM Personal Computer, PC Mouse interfaces via a single RS-232 port without hardware or software modifications. The mouse controls CRT cursor position by optically counting grid lines printed on an aluminum "mouse pad" as the unit moves over the pad. Three mouse-mounted pushbuttons issue nine commands; each command translates into a 15-keystroke (max) sequence. PC Mouse costs $332. An optional $40 Mouse-Window package facilitates software development. **Mouse Systems Corp,** 2336H Walsh Ave, Santa Clara, CA 95051.
Circle 432

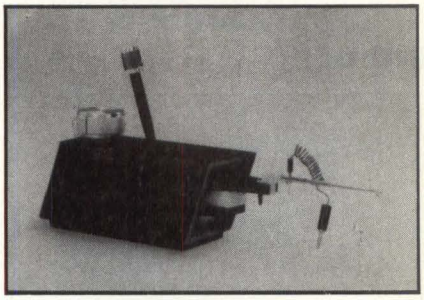
14″ color graphics terminal



Designed for process control applications, Model VTC 8001 is equipped with a high resolution, flicker-free CRT. The terminal has an adjustable viewing angle and low profile, detachable keyboard. It can simultaneously display 8 colors from a 256-color palette. An RS-232-C or 20-mA current loop port interfaces the terminal to a host computer; an additional RS-232-C port drives a color graphics dot matrix printer. Options include a 20″ (51-cm) CRT, RGB output, Centronics-compatible parallel interface, 21 soft keys, a nonglare dark glass CRT, and a speech synthesizer. Single-quantity price is $2960. **Datagraph, Inc,** 2 West St, Weymouth, MA 02190.
Circle 433

June Preview—
Watch for a major staff-written review on nonvolatile semiconductor memories.

Joystick micropositioners



The AMP-1 and AMP-1A series joystick micropositioners provide a 0.5″ (1.3-cm) true linear Z motion of probes, with no corrective positioning needed between scan and contact. One-mil positioning in the X-Y plane is possible anywhere within a 0.5″ diameter circle. Probe tip moves in the same direction as the joystick. Both units accept the full line of Alessi's probe arms and probe tips. Delrin ball joints provide smooth, resistance free movement. Instant extension/retraction of probe arms by 1.5″ (3.8 cm) is possible. The AMP-1A has a 0.75″ (1.91-cm) shorter base for narrower probe platens. **Alessi Industries, Inc,** 3195-C Airport Loop Dr, Costa Mesa, CA 92626. **Circle 434**

High resolution lightpen

DT170M lightpen features high resolution over a wide range of screen intensities, under 250-ns response time, high noise immunity, and std push tip. The lightpen works with black and white or color CRTs, and comes std with a 9′ (3-m) coil cord and modular connector. Selling for under $60 in OEM quantities, the pen makes data entry to menu-driven programs in conjunction with, or independent of, keyboard entry. Customized output configuration, sensitivity, cord length, and connector types are available. **Design Technology,** 7760 Vickers St, San Diego, CA 92111.
Circle 435

Mouse interface to terminals

Universal MU-2 interfaces a mouse cursor to any computer terminal or personal workstation. The intelligent interface allows direct, usable displacement data to be programmed and sent to host or terminal. On-demand or on-motion transmission modes can be profiled; transmission can be turned on or off under program control. Data format can simulate cursor position control signals or cursor key commands. **Random Access, Inc,** 246 Highland Rd, Pittsburgh, PA 15235. **Circle 436**

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LITERATURE

Power supply catalog
Technical data and dimensional drawings profile 15- to 500-W open/enclosed frame linear supplies, 80- to 220-W open frame switching power, 50- to 1500-W submodular switching supplies, 300-W dc-dc converters, and power supply test equipment. ACDC **Electronics**, Oceanside, Calif.
Circle 438

Realtime visual analysis
Bulletin contains technical/operational specs for ERMAC® 2500 series machine vision systems. **Everett/Charles Automation Systems**, Pomona, Calif.
Circle 439

Power supplies
Detailed specs, schematics, bonding diagrams, and packaging information highlight DACs, ADCs, precision op amps and voltage references, analog switches/multiplexers, dual transistors, and special functions. **Micro Power Systems, Inc**, Santa Clara, Calif.
Circle 440

5-V-only EEROM
Application note describes model 5213 16K chip, touching on device operation, system design considerations, and sample system implementations. Figures and text illustrate cell, endurance characteristics, evolution to higher densities, operating characteristics during write/erase, etc. **Seeq Technology, Inc**, San Jose, Calif.
Circle 441

Industrial control packages
Folder covers RacPac 8/12 rackmount enclosures, and how 1872+ basic module and 180+ modular components can be used in harsh data acquisition and control environments. **Xycom, Inc**, Saline, Mich.
Circle 442

VLSI microcircuits
Brochure highlights microprogrammable NCR/32 family chips, which offer features like 16M-byte DMA, 32-bit binary integer precision, and 32-bit register to register addition in one machine cycle. **NCR Corp**, Dayton, Ohio.
Circle 443

Engineering minicomputer
Bulletin presents design, features, and capabilities of MC-500 32-bit multiprocessor based machine, focusing on computing and data acquisition performance. MASSCOMP, Littleton, Mass.
Circle 444

Test and measurement
Catalog specifies instruments and accessories such as waveform analyzers, dc voltage/current standards, DMMs, capacitance/temperature meters, probes, and power supplies. **Data Precision, Div of Analogic Corp**, Danvers, Mass.
Circle 445

Autocatalytic nickel plating
Brochure describes Niklad systems, which chemically deposit nickel-phosphorus or nickel-boron without external power source; uniform coating offers a wide range of deposit properties and meets MIL-C-26074 requirements for nickel-phosphorus. **Witco Chemical Corp, Allied-Kelite Div**, Des Plaines, Ill.
Circle 446

Ultraminiature dc-dc converters
Data sheets specify 700 series 15- to 50-W regulated units featuring wide input voltage range, 6-sided electrostatic shielding, and very low output noise; also covered are 800 and 900 series 5- and 10-W units and 400 series 1- and 2-W units. **Power General**, Canton, Mass.
Circle 447

Membrane switch design
Liberally illustrated design guide explains membrane switch concept and manufacturing, and gives comprehensive specs for electrical and mechanical connections; glossary of terms is included. Request on company letterhead from **Sheldahl, Inc**, Northfield, MN 55057.

VT100 compatible display terminal
Brochure introduces Concept AVT terminal; complete specs and schematic art detail the 132-column, ANSI-standard model from applications developer and interactive user standpoints. **Human Designed Systems, Inc**, Philadelphia, Pa.
Circle 448

Synchro converters and encoders
Data book examines synchro converters, displays, and absolute encoders for synchro/resolver or shaft interfacing requirements; digital angle and metric to English conversion charts are included. **Computer Conversions Corp**, East Northport, NY.
Circle 449

Floating point array processor
Brochure outlines AP500 hardware/software design, specs, and system configurations; three operational modes—attached, independent, and coprocessor—are described for a variety of high speed applications. **Analogic Corp**, Wakefield, Mass.
Circle 450

Custom membrane keyboards
Booklet discusses capabilities of custom keyboards and sets forth technical information comprising membrane types, typical specs, keyboard construction, conductive circuitry, graphic overlays, shielding, and special features. **SMK Electronics Corp**, Placentia, Calif.
Circle 451

Bar-code data entry system
Application note "Elements of a Bar-Code System" examines symbology, media, printer, operator, scanner, decoder, and principal criteria in code selection; an analytical technique for evaluating system errors and determining the decodability of a bar-code symbol is included, along with bar-code standardization references. **Hewlett-Packard Co**, Palo Alto, Calif.
Circle 452

Low horsepower dc motors
Tear sheet gives an overview of permanent magnet motors in industrial applications; motors come in 1/8 to 2 hp and operate at 1150 to 3250 rpm; they are furnished with ODP, TENV, or TEFC enclosures, and class F insulation. **Reliance Electric Co**, Cleveland, Ohio.
Circle 453

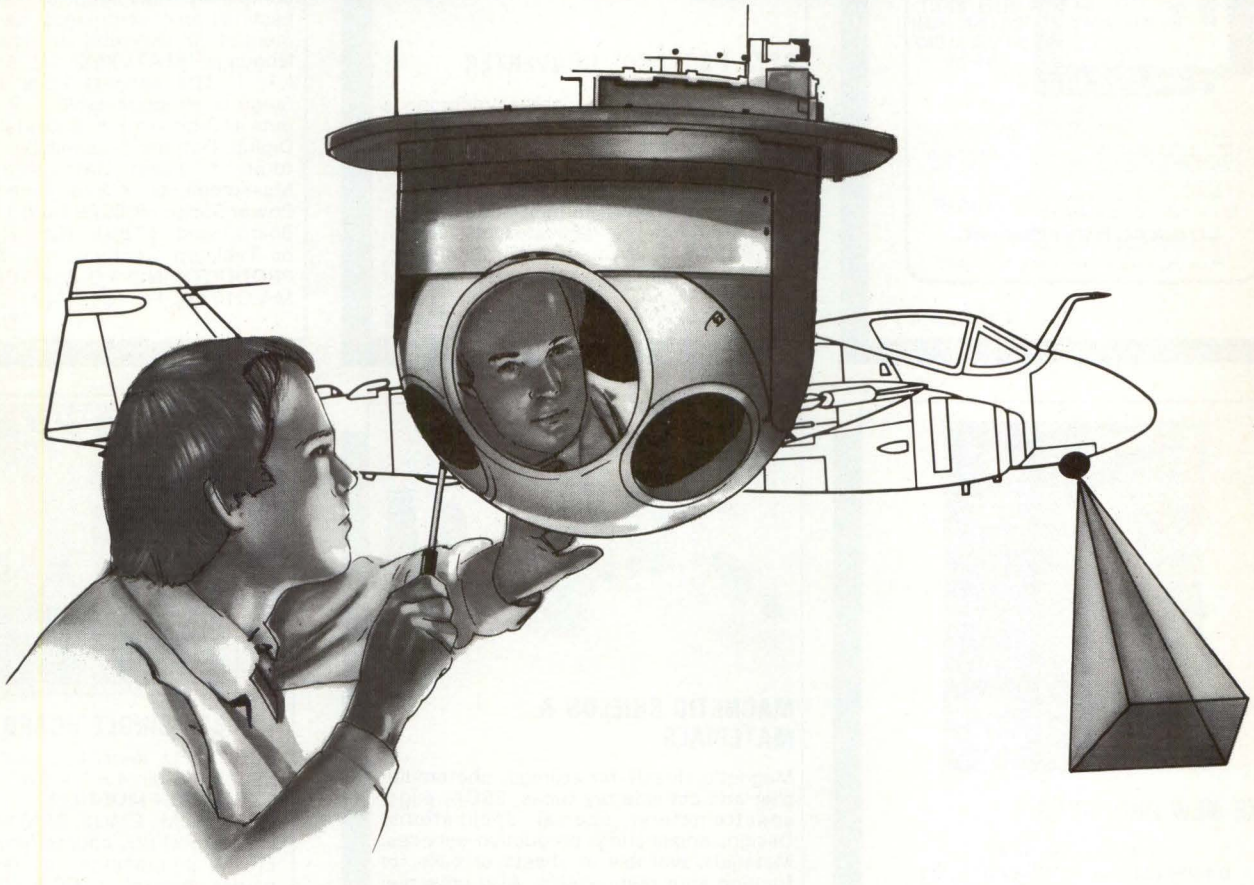
Capacitor guide
Catalog gives performance and electrical specs and reviews selection criteria for typical applications; types covered include metallized polycarbonate dielectric, metallized polypropylene, metallized polyester, polyester dielectric, polystyrene dielectric, and polyester dielectric RC network. **TRW Capacitor Div**, Ogallala, Neb.
Circle 454

Bipolar programmable power
Pamphlet profiles Bop series 100-, 200-, and 400-W, 4-quadrant power supplies, which accept plug-in digital Bit interface card that provides parallel data or IEEE 488 control; panel-mounted mode selector switch gives full programmable control over both voltage and current. **Kepco, Inc**, Flushing, NY.
Circle 455

D-subminiature connectors
Product guide cross references major manufacturers with military parts numbers and examines original D-D*, Frugal D-FD*, Norman D-8634, MIL-C-24308 solder-D*M, combination layouts-D*MW, and MIL-C-24308 crimp-S*MA, along with 8630 series accessories. **Souriau Inc, sub of Souriau & Cie**, Valencia, Calif.
Circle 456

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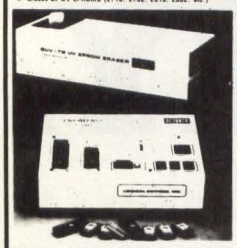
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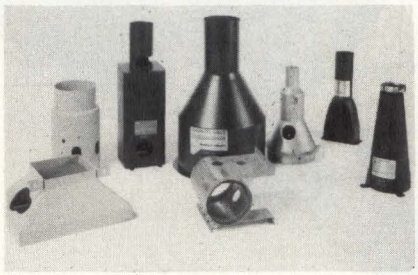
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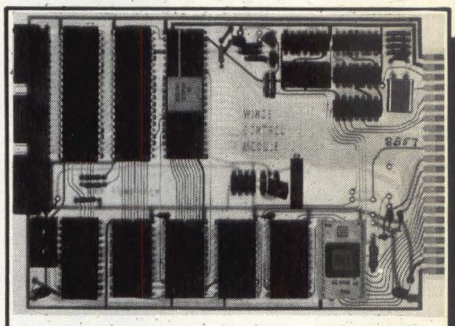
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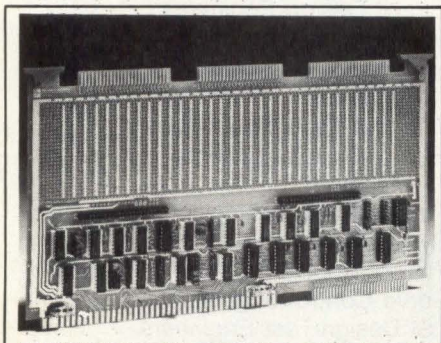
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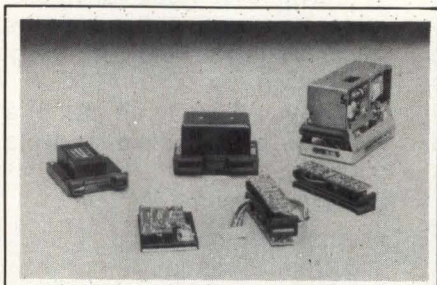
CIRCLE 478



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CIRCLE 479

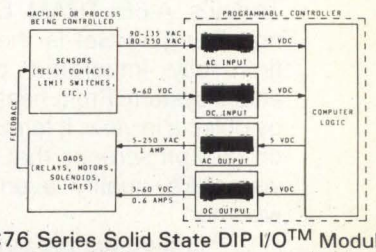


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C76 Series Solid State DIP I/O™ Modules are designed for use in computerized control systems for noise-free isolated interfacing of computer logic elements to harsh industrial environments. Modules employ custom microcircuits in a TO-116 DIP. Low "Per-point" cost. Meets VDE spacing and voltage requirements. Features CMOS and TTL compatibility, optical isolation, high noise immunity and an ENABLE function on input modules. $7.75 to $8.95 (depending on function) at production quantities. **TELEDYNE RELAYS**, 12525 Daphne Ave, Hawthorne, CA 90250. Tel: (203) 777-0077.

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CIRCLE 482

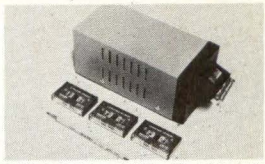


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CIRCLE 483

RS232 or 8 BIT PARALLEL MINI CASSETTE SYSTEM



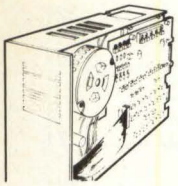
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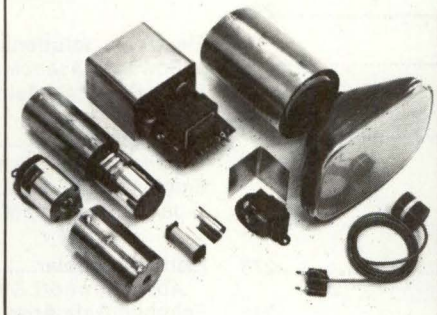
NCC @ BOOTH S5600 **CIRCLE 484**

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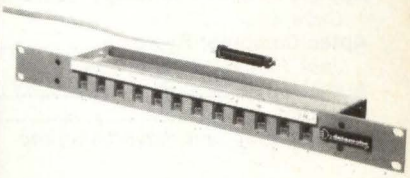
Unused Shugart 8" SA1002 5.3 Megabyte hard disk drives available for $380 each in their original shipping cartons. Controller for this drive (WD 1001-85) $350. Call **LIQUIDATORS** at 803-877-9828 or send check or money order to 105 S, Main Street, Greer, SC 29651.



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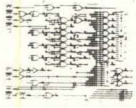


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CIRCLE 487

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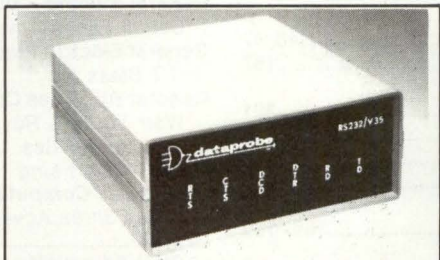
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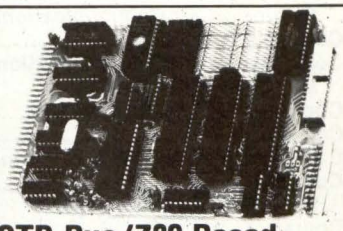
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DATA INTERFACE CONVERTERS FOR V.35

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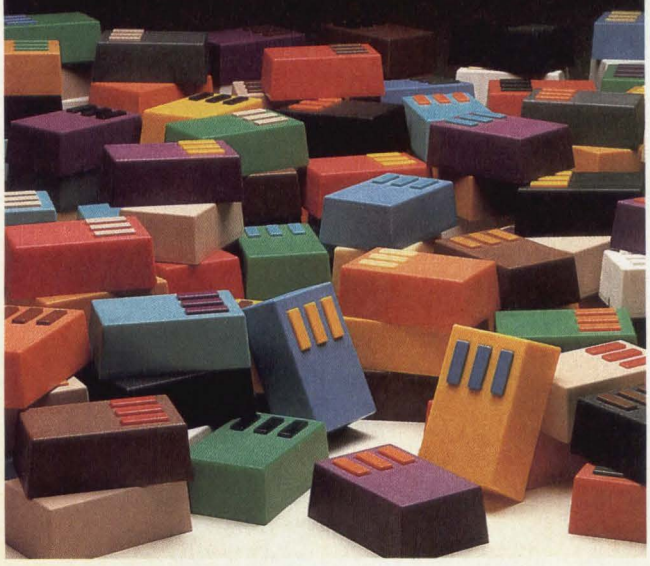
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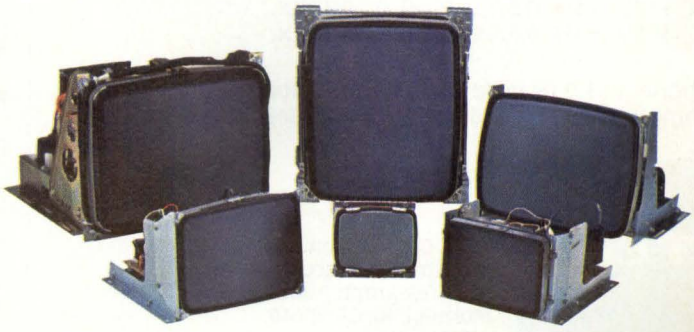
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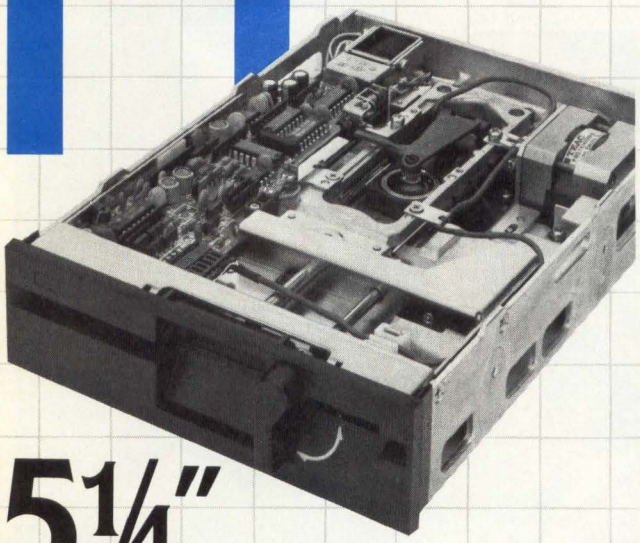
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• single side	• double side	• single side	• double side

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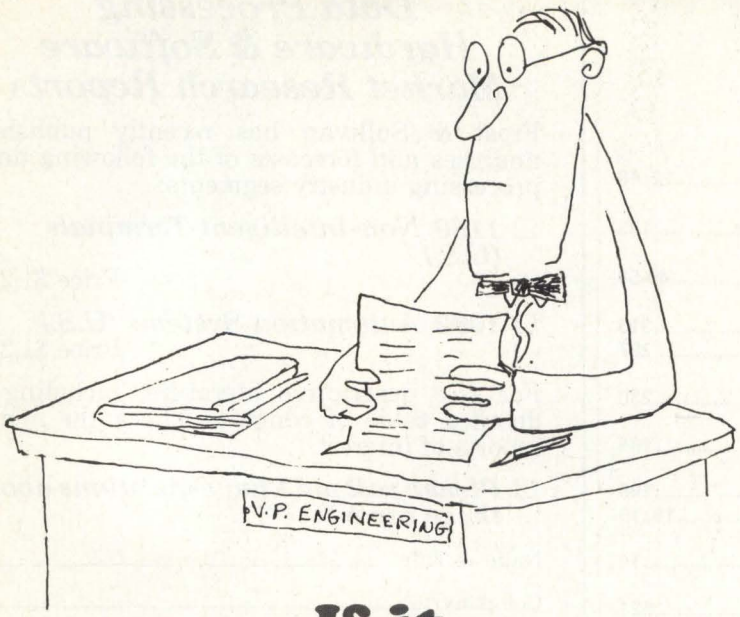
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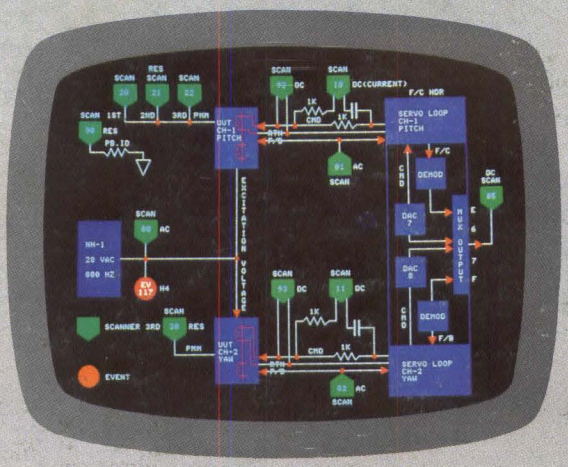
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